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WILLIAM F. RIGGE.

By THE REVEREND JAMES McCABE, S. J.

Reverend William F. Rigge, S.J., Professor of Astronomy at Creighton University, Omaha, died March 31, 1927. He was born in Cincinnati Sept. 9, 1857, and after his grade school studies entered St. Xavier College, Cincinnati. He graduated in 1870. Five years later he entered the Jesuit Order. Three years afterwards (1878) he was selected as one of the first faculty of the nascent Creighton College, Omaha. He spent three years at Creighton at this period. Then he entered upon the first phase of the distinctive Jesuit education, which is a three years' course in philosophy, mathematics, and the sciences. His first year in philosophy was spent at St. Louis University, St. Louis, Mo., and the two following years at Woodstock College, Woodstock, Maryland. Here he had the good fortune to have as classmate John T. Hedrick, a brilliant and experienced mathematician and astronomer. It was from Father Hedrick that Fr. Rigge received his vocation for mathematics and astronomy, and it may be truly said that for the rest of his life he never wavered in his devotion and application to these two studies. Fr. Hedrick was an exacting master, as becomes one who teaches these sciences, and he found Fr. Rigge an eager and fit pupil.

After his course in philosophy, Fr. Rigge was sent to St. Ignatius College, Chicago, where for three years he taught the sciences, mathematics, and astronomy. Then he returned to Woodstock College, Maryland, for his final studies as a Jesuit, and entered upon a four years' course in theology. Here he was ordained priest by Cardinal Gibbons in June, 1890. One year afterwards he entered upon a course of teaching in St. Louis University, St. Louis, Mo., where he spent four years in teaching mathematics and astronomy to the younger members of the Jesuit Order in the Scholasticate attached to the University. The scholastic year of 1895-1896 he spent at Georgetown University as associate to Father John G. Hagen, S.J., who was then in charge of the Georgetown Observatory, and who a short time after was called to be the head of the Vatican Observatory in Rome. Fr. Rigge received the Ph. D. degree from Georgetown University at the end of the year.

In 1896 Fr. Rigge returned to Creighton University, Omaha, which had developed greatly from the young college of 1878. But the organization and the building up of the science department and the Observatory—all had to be done; no small task for one who had little means at

his disposal. But patience and persistence, with a clear idea of what could be done and what could not, stood Fr. Rigge in place of a larger sum of money, with the result that the Physics department came in reasonable time to be fully equipped, and the Observatory, which was his special care, was soon so well established that, for a small observatory, nothing more could be desired. The Observatory today is fully equipped for all the needs a small observatory can meet.

Fr. Rigge remained constantly on the staff of the Creighton University from 1896 till the time of his death. By word and example he taught his students to make use of all the knowledge they possessed, and he encouraged them to go far afield in research work. A point which he insisted on, and which he himself continually practiced, was to publish in some form the results of their work. His writings have appeared in POPULAR ASTRONOMY, *Astronomische Nachrichten*, the *Astrophysical Journal*, the *Technology Quarterly*, the *Scientific American*, *Science*, and publications of the *United States Naval Observatory*. Besides there were innumerable answers given to the press on timely subjects, such as eclipses, occultations, conjunctions, the nearness of Mars, reasons why Mars is not populated, and a thousand and one questions which people will ask about the stars, the planets, etc. One typical instance of his work of this kind was when he made the sun give proof that the evidence brought against a certain man could not be true. The man was charged with placing an infernal machine (a dynamite bomb in a suitcase) on the porch of one who was supposed to be his enemy, and two girls who were the sole witnesses testified that they saw the man on the porch about 3 o'clock, P.M. The suitcase was placed on the porch between 2 and 3 o'clock. Now these two girls had been at a church a mile away, and while there they formed part of a group photograph. This photograph had a shadow on its surface. The year was 1910, and the date, May 22. From the shadow Fr. Rigge declared that the photograph had been snapped within one minute of twenty-one and one-half minutes after three. On the anniversary of the picture another test photograph proved that Fr. Rigge had named the time within a quarter of a minute. The accused man was freed.

In 1924 Fr. Rigge published his first book, "The Graphic Construction of Eclipses and Occultations." This is a very useful and practical help to the young astronomer. Another book, which he published in 1926, is "Harmonic Curves." For the latter work he spent ten years in devising and perfecting a machine for drawing such curves. This machine is called "The Creighton Harmonic Motion Machine," and it has been given wide publicity. Indeed it well deserves it, for with it can be drawn seven billion distinct harmonic curves, as compared with 937, which was the previous record. Those who are interested in these curves will find innumerable illustrations of them in "Harmonic Curves."

Frail of physique and of kindly, gentle manner, with keen mental

powers, a burning zeal for his work, his imagination kindled with life of research "among the stars," the personality of Fr. Rigge will never be forgotten by the thousands who knew him well. Perhaps the pursuit of the real student of astronomy has a distinctive effect on the individual which so concentrates his interests that non-essentials do not worry or appeal to him. Fr. Rigge had his big work to do, and, wholly absorbed in his vocation, he industriously hewed his way in his life task. But he was not without a sense of humor, which tempered his philosophy, made light of difficulties, and kept him cheerily along his even way. The big things were his science and his boys, whom he sought to inspire with the subject in hand. Gentle and courteous, he was firm and determined, not only in his personal life and conduct, but in his classroom work. His scholarly attainments were widely recognized. He held fellowships in the American Association for the Advancement of Science, in the Royal Astronomical Society of England, in the Astronomical Society of the Pacific, in the Société Astronomique de France, and in the Nebraska Academy of Science. He was singularly fortunate in more than half a century of conspicuous service, in which time he saw Creighton University develop from a small beginning into a great school, numbering its students from many states, its graduates high in places of honor and usefulness. Those who came in contact with him will ever remember the figure of the fervent scholar in his observatory at Creighton, and the kindly Christian gentleman in his walks of everyday life.

The Creighton University, Omaha, Neb., April 13, 1927.

WHERE IS THE HORIZON ON YOUR SKY MAP?

By G. B. BLAIR.

When one comes to use the ordinary rectangular sky maps, such as those in Young's *Uranography,* he begins to appreciate the inconvenience arising from the fact that there appears to be no simple way of determining the horizon line on the map for any given time of observation. The student does not have much difficulty in locating constellations which lie near the meridian but he is utterly at a loss to determine what star groups lie near the horizon in the eastern and western sky. The horizon finding card, as I have called it, offers a simple solution of this difficulty.

As adapted to Young's *Uranography,* the horizon finding card is a small piece of cardboard, about four inches long and three inches wide, shaped as in Figure 1. There are four possible positions in which the card may be placed upon the map which give the four quadrants of

the horizon which lie between the north, south, east, and west points of the horizon.

In using the card, the first step is to locate on the map in the usual way the hour circle corresponding to the meridian at the time of observation. Then, let us suppose that the student wishes to find the eastern horizon, north of the celestial equator. He turns the card with the face upward upon which is lettered, "East Horizon, North Declination, Point on 6 Hours East," and holds the card so that this lettering is right side up as he sits facing the map. Next he lays the edge of the card marked "Equator" along the celestial equator of the map with

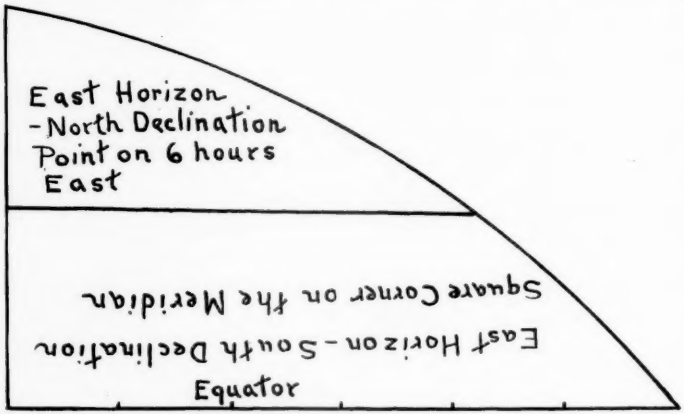


Figure 1.

the acute angled point on the hour circle that is 6 hours east of the meridian. The curved edge of the card then indicates the position of the part of the horizon indicated by the lettering that is right side up.

In a similar manner the other three quadrants of the horizon may be found. The edge marked "Equator" in every case lies along the equator of the map and the lettering describing the section of the horizon desired is right side up.

Figure 2 shows the four possible positions of the card. The curve is the outline of the entire horizon as it would appear if drawn on the map at the time of observation. The edge of the card marked "Equator" is divided into six equal divisions, each one hour long. These are convenient when the horizon curve extends beyond the particular map on which it crosses the equator. Thus, in the example just given should the hour circle six hours east of the meridian lie only two hours from the edge of a certain map, the card may readily be transferred to the next map of the series by placing the second mark from the acute angled point of the card on the hour circle of the second map having the same number as the hour circle at the edge of the first map.

If desired, the entire curve of Figure 2 may be drawn upon a sheet of transparent celluloid. The meridian line of this sheet then need only be placed on the meridian line of the map to locate at once the part of the horizon lying upon the particular map of the set that is in use. Such a horizon indicator, for a map of the size of Young's *Uranography,* would have a minimum length of about 17 inches and would not be very easily portable. The arrangement would hardly be feasible at all for large maps. The simple horizon finding card, on the other hand, may be folded into the map sheets with which it is used.

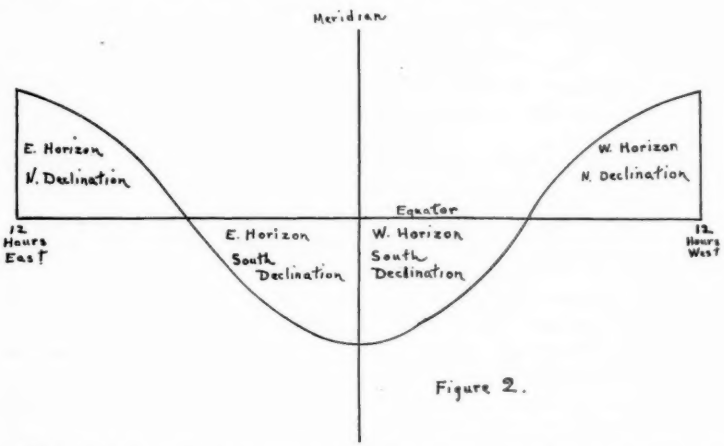


Figure 2.

The horizon cards are easily made in quantities after a pattern has been prepared. To prepare the pattern, the hour angle of a star when on the horizon is computed from the formula

$$\cos t = -\tan \delta \tan \phi$$

for every 10° of declination from 0° to 90° $- \phi$. In the equation t is the hour angle expressed in arc, ϕ is the latitude of the point at which the map is to be used, and δ is the declination. The computed hour angles should be reduced to hours and decimals of hours. The resulting values, each decreased by 6 hours, may now be plotted with reference to any chosen hour circle of the map. This plotting should be done in lead pencil. The curve thus obtained forms one boundary of the desired horizon finding card and the hour circle six hours from the chosen hour circle and the equator form the other two boundaries. A copy of this figure is transferred to a piece of thin cardboard, the two faces of which may then be lettered as indicated in Figure 1. Note that each face of the pattern has two sets of lettering one of which is the opposite side up from the other. The pattern is completed by carefully trimming the edges along the boundaries of the figure.

It has been the custom of the writer to prepare blank copies of the

pattern for each member of his class in astronomy. The students themselves fill in the lettering by referring to rough drawings placed on the blackboard. At least one laboratory period per year is devoted to practice in the use of the horizon finding card. The maps are carefully removed from the text so that they may be spread out flat when using the card on them.

Problems such as to find the approximate time of rising or setting of the sun, moon, planets, or fixed stars may be solved by the use of the cards. The difference between the times of rising and setting of two heavenly bodies may be found by plotting their ephemeris positions on the map. The east or west horizon line, as the case may be, is then set on one of the bodies and the card is moved along the equator until the horizon falls on the other body. The amount of shift of the card along the equator indicates the difference in time of rising or setting.

The table submitted with this article gives the hour angle on the horizon for selected declinations for every five degrees of north latitude from 25° to 50°. By its use a horizon card may be constructed for any latitude within the limits of the United States. To locate by means of the table a horizon line that is correct to about the nearest degree of latitude perhaps the simplest method of procedure is to plot on the map the curves between which the desired curve lies and then to draw in that curve in the proper position between them. For example: to find the horizon curve for 43° north latitude plot the curves for 40° and 45° and draw in the curve for 43° so that it lies everywhere three-fifths of the way between the other two curves.

For maps about the size of those in Young's *Uranography* or those in Moulton's *Astronomy* the hour angle to the nearest tenth of an hour is sufficiently accurate. Hundredths of an hour are tabulated for the convenience of those who may wish to construct cards for maps of larger size.

	Hour Angles of a Star in the Horizon at Latitudes					
Declination	25°	30°	35°	40°	45°	50°
10°	6ʰ32	6ʰ39	6ʰ47	6ʰ57	6ʰ68	6ʰ81
20	6.65	6.81	6.99	7.18	7.42	7.71
30	7.04	7.30	7.59	7.93	8.35	8.90
38						10.57
40	7.53	7.93	8.40	8.98	9.80	12.00
43					10.59	
45				9.80	12.00	
50	8.25	8.90	9.77	12.00		
53			10.56			
55			12.00			
57		10.18				
60	9.59	12.00				
64	10.86					
65	12.00					

University of Nevada, Reno, Nevada.

THE SOLAR CYCLE IN TEMPERATURE AND IN CROPS.

By CHARLES CLAYTON WYLIE.

The average class in astronomy is told that the solar cycle of eleven years is shown by variations in the number, size, and latitude of sunspots; by variations in the prominences, flocculi, corona, solar constant, and in other ways. The class is also told that the cycle is shown by variations in the number and intensity of terrestrial magnetic storms, earth current disturbances to telephone and telegraph lines, and auroral displays. In my own experience, students who have seen the newspaper and popular magazine articles connecting sunspots with wars, tropical hurricanes, etc., occasionally ask questions. Students majoring in economics have mentioned the work of Jevrons on the solar cycle in business. Although this is dangerous ground, I last year decided to utilize some of this interest on the part of good students, and directed the making of some graphs outside of the regular class work. The plan adopted was simply the forming of a mean curve for one cycle from records covering three to five cycles. Overlapping means were used to further smooth out the large variations not associated with the cycle. As an index of solar activity the Wolf-Wolfer sunspot numbers were used, and the mean sunspot curve formed for one cycle in exactly the same way as the mean curve for whatever was being investigated. As these curves proved of more interest than anticipated, others may consider them of value in deciding on the evidence for or against the various relations claimed by different writers.

The first curves were from the Iowa Weather and Crop Service records covering the years 1892-1924 inclusive (33 years, or three solar cycles). From these adoptions, curves were formed showing for that period and for the state of Iowa the following mean curves for one cycle; mean annual temperature, total annual precipitation, and the average yield per acre in the state for corn, winter wheat, and oats. The mean sunspot curve for those years was formed as stated above. Figure 1 shows the result. At the top, the solid line shows the sunspot variation, and the dotted line the temperature. The sunspot curve is repeated at the bottom, and the dotted line shows the result for precipitation. Above the precipitation is the curve for oats, above that the one for wheat, and just below the temperature curve that for corn is plotted.

It is apparent that the temperature curve is roughly an inversion of that for sunspots. An increase of solar activity has, for this period on the average meant a lower mean annual temperature for the state of Iowa. The precipitation curve is irregular. Corn is in a general way parallel to the temperature; that is, the best corn crop in Iowa has been

in the warmer years on the average. Wheat follows the temperature also, but is influenced by precipitation. It averages best in the warmer and drier years. Oats is little influenced by the mean temperature, but

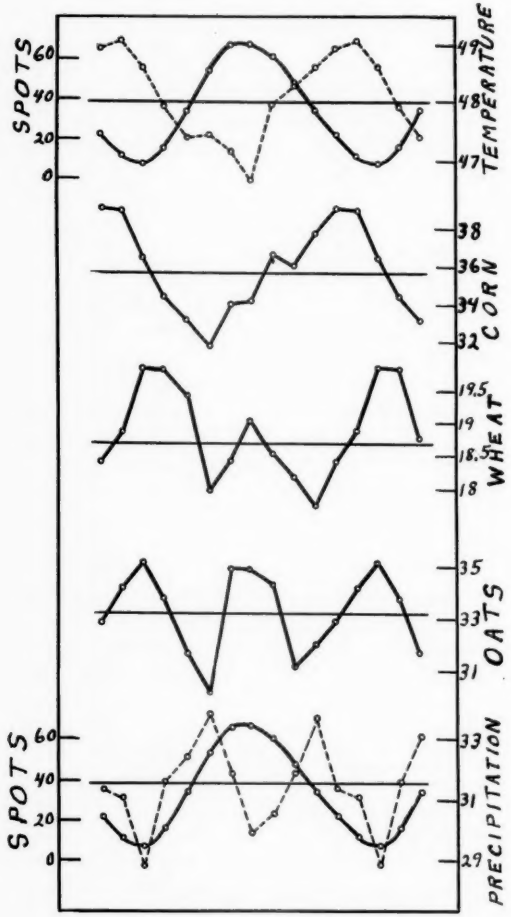


FIGURE 1.

it is noticeable that the record is very nearly an inversion of the precipitation curve. This crop has been better in the drier years.

To show the temperature relation further, the weather bureau adoptions for mean annual temperature of the New England section were treated in the same way, using again the years 1892-1924 inclusive.

The result is shown in Figure 2, which is similar to the curve found for Iowa, but with a smaller extreme variation. For this section, there is not as good an inverse relation as for Iowa. The temperatures seem rather to follow the sunspot curve with a lag of four years, as is shown by plotting them with four years subtracted from the phases. An inspection of Figure 2 will show that these points are very close, almost surprisingly close to the sunspot curve. It should be said that a temperature variation in the solar cycle has for some years been considered established by meteorologists. A graph in the back of Humphrey's "Physics of the Air" shows the sunspot numbers and "world temperatures" plotted together for the period 1750 to 1913 inclusive.

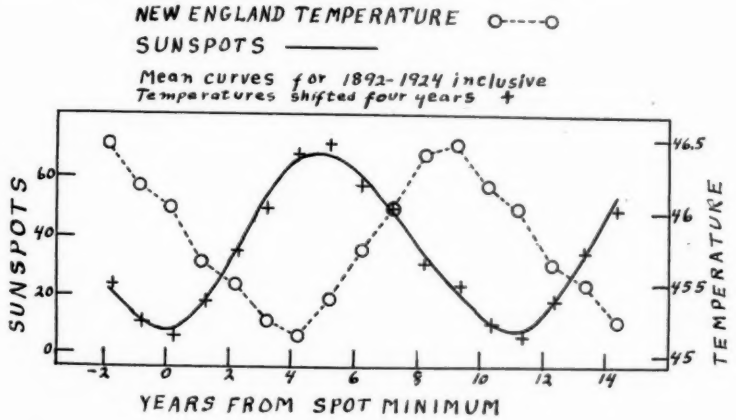


FIGURE 2.

Using records of the average yield per acre of Iowa corn furnished by the Bureau of Agricultural Economics of the Department of Agriculture, the curve showing the variation of Iowa corn throughout a solar cycle was formed from the five cycles (fifty-five years) 1871-1925 inclusive. Overlapping means were used as in the previous curves. The mean sunspot curve for the period was formed exactly as the corn yield curve. Figure 3 shows the result. The maximum and minimum for corn occur about a year before the minimum and maximum respectively for sunspots. Except for being a year out of phase, the corn record is a fairly good inversion of the sunspot record.

To summarize the results, we can say that, for the 33 years 1892-1924 inclusive, temperatures in Iowa and New England averaged lower in years of solar activity, the difference being a little greater in Iowa. For Iowa the mean sunspot and temperature curves show a correlation coefficient of —0.75. For New England, the coefficient is —0.63. For the same years, the yield of Iowa corn has averaged less in years of solar activity. A curve based on the longer period 1871-1925 shows

an even better inverse relation. For these years the correlation between the mean sunspot and corn yield curves is —0.87. Winter wheat seems to have averaged slightly less in years of solar activity, but to have been affected by variations in precipitation more than corn. The curve for oats yield based on the years 1892-1924 is very nearly that for precipitation inverted, but neither curve shows a simple direct or inverse relation with that for solar activity. The mean sunspot and precipitation curves show a correlation coefficient of +0.03, or practically zero.

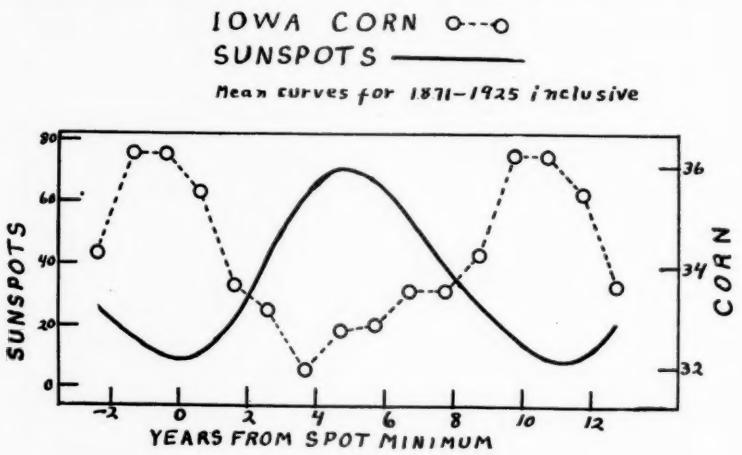


FIGURE 3.

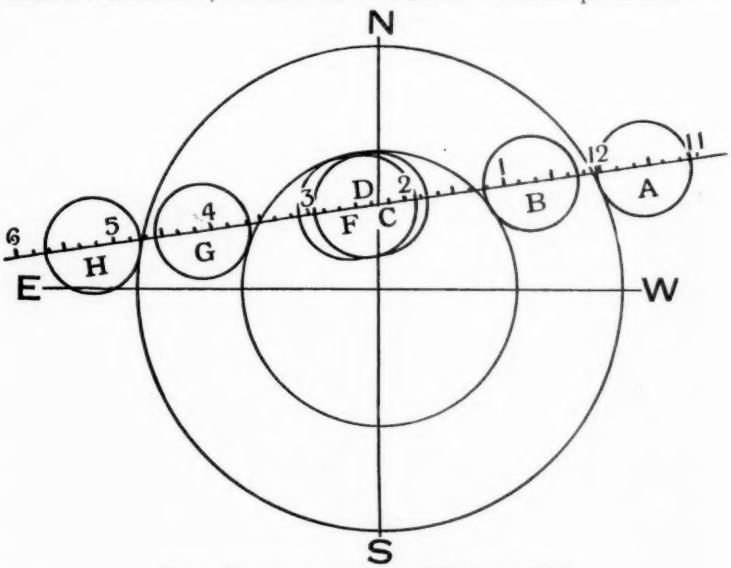
In a note of this nature it is well to state that the cyclic variations suggested by these curves are much smaller than those due to other causes occurring from year to year. The temperature variation is accepted as real by meteorologists, but they are venturing no long distance forecasts. Further, proving a cyclic variation for one section does not prove it for all. The temperature change, which is accepted as real, may be considered a shift of the isotherms, and this presumably affects the tracks of storms across the United States. The change in storm tracks may conceivably have one effect in one part of the country and exactly the opposite in another.

University of Iowa Observatory, March 10, 1927.

TOTAL ECLIPSE OF THE MOON 1927, JUNE 14-15.

By WILLIAM F. RIGGE.

On the night of next June 14-15 there will be a total eclipse of the moon visible all over the United States. The annexed drawing gives a picture of it. The largest circle is a section of the earth's penumbra, and the next in size one of its shadow, at the place where the moon will cross them, N S E W being the cardinal points. The oblique line is the moon's path, and the small circles on it represent the moon at important moments. When it is at A at 11:34 P.M. on the 14th, Central Time, the moon enters penumbra. At B at 12:43 A.M. on the 15th, the moon enters shadow. At C at 2:13, it is completely immersed in the shadow and the Total Eclipse begins. At D at 2:24 there is the Middle of the Eclipse. At F at 2:35 the total eclipse ends. At G at 4:06 the moon leaves shadow, and at H at 5:15 the moon leaves penumbra.



TOTAL ECLIPSE OF THE MOON 1927, JUNE 14-15.

The duration of totality is only 22 minutes, during which time the moon may either be entirely invisible or shine with a beautiful copper color. Which of the two will happen cannot be predicted, because this depends upon the fact whether or not there will be clouds on the sunrise and sunset circle of the earth to intercept the sunlight and prevent it from being bent by refraction into the shadow.

The magnitude of the eclipse is 102 percent, that is to say, the moon sinks 1.02 times the length of its diameter into the shadow.

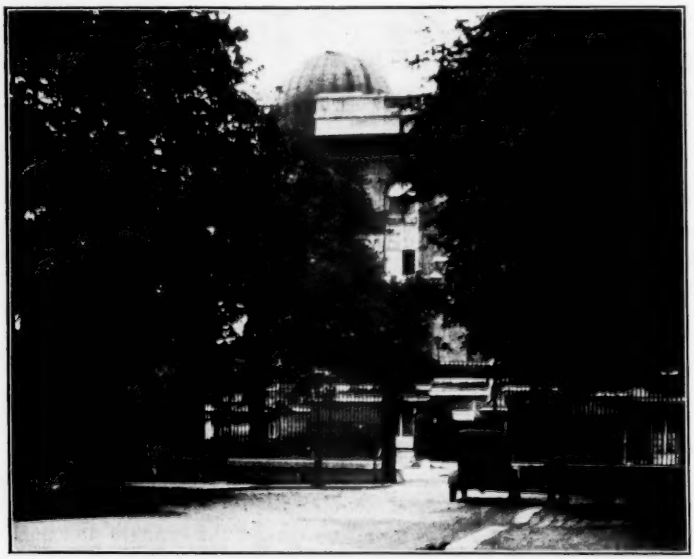
THE ASTRONOMICAL FRATERNITY OF THE WORLD.

By DAVID B. PICKERING.

PART II.

We left the city of the Doges in its glory to revel for a fortnight amid the splendor of the Italian lakes, and watch the changing panorama of light and shade as the great clouds floated majestically between the snow-capped peaks of the mountains and the white-dotted groups of villages at the water's edge.

Then one evening, we left our hotel at Stresa—on Lake Maggiore—, cast a fond last look toward Isola Bella, and boarded the continental express. We awoke next morning in Paris—Paris, the play-ground of the world. Standing for the first time in the Tuileries Gardens, between the strong, enfolding arms of the Louvre, and gazing westward down its statue-adorned length toward the Eiffel Tower and distant Arc de Triomphe, one is emotionally overwhelmed with the consciousness of the moving drama—the Tragedy and Comedy—that has been enacted upon this civic stage. Here, perhaps, is the center of Life in the world today. Just over the Seine to the south lies the Latin Quarter—that in-



ENTRANCE TO PARIS OBSERVATORY.
Head of Avenue de l'Observatoire, Paris.

definite area wherein are the Luxembourg, the Pantheon, and the Sorbonne—with its great artery, the famous "Boul Mich" which leads from the river out towards the Observatory of Paris. What a garden-street of dreams is that Avenue de l'Observatoire! Stretching like a narrow park, whose paths lead beneath symmetrically trimmed trees, from the old Luxembourg Gardens to the tall iron fence that guards the observatory grounds. So thick are the trees and foliage about the ancient edifice, that one glimpses from a distance only the largest of its several domes and must approach close to the slender fence before spying the statue of Leverrier which stands grimly between it and the portal. It was not difficult to obtain admittance from the little man in the porter's lodge and there was a thrill in the solitude of the ramble through the surrounding grounds, among the many lesser buildings half concealed by dense shrubbery and trees. Heavy walls on three sides border the undulating area. Everything was green and the air sweet with the scent of newly cut grass. So pleasant a place to loaf and invite thoughts of the past—and the slow progress of achievement—that one was loath to leave it and enter the cold portal of the historic observatory.

Colder still, in fact and effect, is the bare masonry of its interior. A great spiral stairway winds seemingly interminably upward about an open well. At the second landing is the door of the Director's office. Here was found the venerable gentleman who so long has controlled the destinies of this famous institution. Professor Baillaud is a very old man, quite deaf and speaking no English. But he nevertheless, succeeded, with the aid of an assistant who could speak a little German, in making himself understood sufficiently to interest his guests in the fine expostion of ancient instruments, portraits, and documents that fill several adjoining rooms. We were courteously invited to attend a lecture in the afternoon and to make an inspection of the telescopes.

The former was delivered by a member of the staff and we were given to understand that it dealt with the history of the institution rather than with its activities. Perhaps one hundred men and women evinced their appreciation by repeated applause while we sat uncomprehendingly at attention. Later we mounted to the summit of those winding stairs and visited the three domes on the great roof—the largest housing a 24-inch refractor. From there we enjoyed also the splendid panorama of Paris that extended below us.

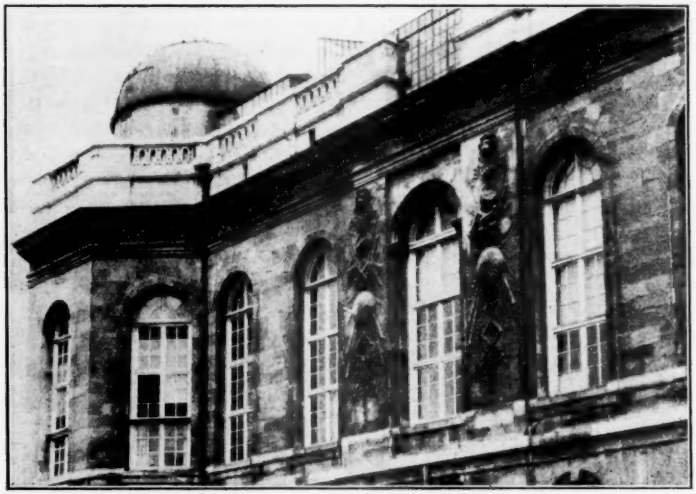
We loitered so long that all had gone below before we realized that the hour was late and that we too must depart. The light was now dim in the great stairwell, but sufficient to show us a card tacked to a door, midway in our descent. We paused, casually, to read:

LABORATOIRE D'OPTIQUE DINA.
PROFESSEUR G. W. RITCHEY.

Instantly we realized that somewhere behind that closed door, significant astronomcial history was in the making; that the man who had

ground and figured the world's largest mirror might be engaged even now in an undertaking of world-wide interest and importance. The desire and curiosity to learn more of this enterprise overcame the reticence we felt at attempting an intrusion, and after finding a lone porter in the silent halls below, we sent in a card. Soon the door had closed behind us and we could well imagine ourselves in the mysterious environment of some Genie of the "Arabian Nights."

Giant cranes and motors were massed incongruously beneath long overhead tubes of colorless incandescent light that seemed to X-Ray the wierd engines among which we stood. Here, there and everywhere reposed great circular discs of wood from three to eight feet in diameter. Steel tracks crossed the floor. Great chains and massive iron hooks hung from the ceiling that rose twenty or thirty feet above our heads. Long, low tables of black iron seemed awaiting the process of some inquisition.

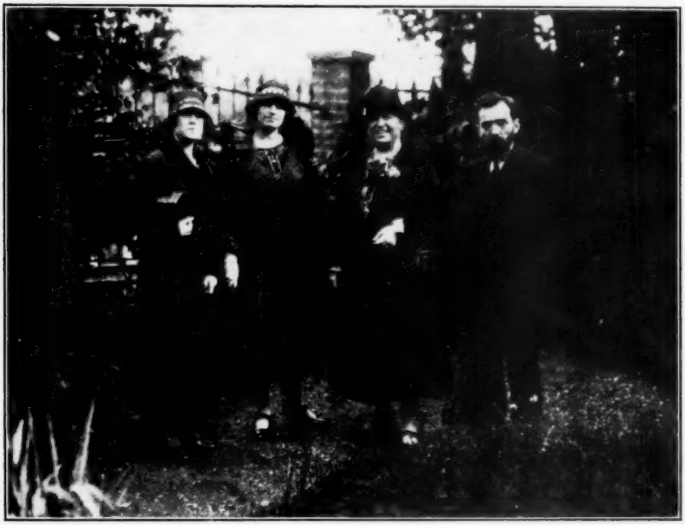


REAR OF PARIS OBSERVATORY.
Windows between and on either side of insignia look from the studio of Professor G. W. Ritchey.

Awesomely we stole into an adjoining chamber walled with cases containing vast tomes, and here at a table strewn with charts and diagrams sat the man who, alone of all men, seemed prepared to eclipse, two-fold, his colossal accomplishments of the past. A good-sized, fine looking man is Professor Ritchey. An iron-gray man whose deepset eyes, beneath heavy brows, have a rather tired look—bespeaking the temperament and energy of the human machine they serve. Here we learned the story of his coming to Paris, of the commission to build a

glass of huge aperture—to be the largest on earth—, of the unique construction contemplated for the mirrors and of the new curves that were to supersede the parabolic. Here were drakings of new mountings that prophesied great reduction in bulk and saving in cost with maximum faculty of operation. We were shown many enlargements of the exquisite photographs taken with the 60-inch at Mt. Wilson, and we listened to a discussion of the delicate art of guiding a great telescope during long exposures.

It is little wonder that as we closed the tall iron gate of this silent home of science and started in the Paris twilight toward Mount Parnasse, we were thrilled with our first visit to the laboratory of Professor Ritchey. On many subsequent visits we were to learn more of a great plan and observe the progress of its development.



Garden of Professor Henri Chrétian's Home, St. Cloud, France.
Left to right: Yvonne Chrétian, Mrs. Chrétian, Mrs. Pickering, Professor Chrétian.

Shortly after our arrival in Paris we had received a call from Professor Henri Chrétian of Saint Cloud. This little gentleman with the sandy beard and twinkling eyes contributed immensely to the pleasure of our visit. Often we foregathered with him and his charming wife and daughter at their hospitable home or at some quiet café off the Boulevards.

It was hard to determine which of Professor Chrétian's two major attributes was the stronger: his sense of modesty or his sense of humor. Because of the former, we were long in learning that he had been the

creator of the new curves for mirrors of which Professor Ritchey had so enthusiastically told us. Also that he was an associate of Professor Chas. Fabry on the staff of the Institute d'Optique—where France tests her optical glasses of all kinds, and where, at the time, a new twelve-foot dome was nearing completion. Professor Chrétian is a practical dreamer—a man of imagination—whose learning and experience aid him in making many of his dreams come true. There was one delightful afternoon spent in the study of the little home in Saint Cloud, after a luncheon of good things from the home garden, when Professor Chrétian told of the time he had spent with Ritchey in America in 1910 while the latter was engaged in constructing the 100-inch mirror. It was this association that led to their affiliation fourteen years later, and of the adoption by Professor Ritchey of the new Chrétian curves and the determination to call the proposed product the "Ritchey-Chrétian," despite the protests of the modest little Professor of Saint Cloud.

He told also of his life at Nice, where with his wife and young daughter he had subsequently spent nine or ten happy years on the staff of the observatory that overlooks the blue Mediterranean. The daughter, Yvonne, nearing her twentieth year, is following in the footsteps of her illustrious father and is studying higher mathematics at Versailles. Here, for the first time, I learned of the merger of those great glass factories that have produced the discs for our largest telescopes: The Parra Mantois Co. and that of Saint Gobain.

There came a day later on, when I met Professor Ritchey in the observatory grounds just as dusk was gathering. Our inspection of some of the old instruments—long discarded and entombed among the shrubbery—was interrupted by one of those sudden squalls that only Paris can produce. Fearful that the strength of the gale might crush a window of the laboratory, we rushed through the rain to the main building and mounted the endless spiral stairs to the silent sanctuary of his own domain.

Here, high up and alone in the great stone edifice, under the uncanny light from the mercurial tubes over head and with the lightning flashing outside, we discussed until after midnight, the future of astronomical progress and telescopic improvement and refinement. The new curves were explained and methods of testing demonstrated; the latter by means of the interference lines seen through a lens superimposed on a flat under the colorless incandescence from the tubes overhead. Here I had my first insight into the methods of guiding a great telescope during the exposure of a plate and was appalled at the training, skill, and patience required to attain satisfactory results. Here, for the first time, I saw the new "built up" mirrors—one of 36 and one of 60 inches. The former, with its secondary glass was just ready for the final laboratory test and was the first of its type ever to be finished. I observed the pierced walls that connected and ventilated the upper and lower discs, all sections of which were about five-eighths of an inch in thickness

and cemented together so delicately along the polished edges of contact that the adhesive material seemed resting only in the microscopic pores of the polished surfaces and, being quite invisible, gave the effect of the whole being cut from a solid piece of crystal. The sixty-inch still rested upon its bed of heavy vertical springs, each about two inches in height and the width of the cell walls. These were in rows, reticulated to come directly under the vertical walls of the cells beneath the polishing surface and, being curved to approximate the curve of the mirror, tend to an even distribution of pressure. As I stood fascinated watching these entirely new engines, whose huge prototype was destined to reach out into space almost beyond the limits of imagination, Professor Ritchey remarked: "There is no reason why, with this method, we cannot make them ten meters in diameter." It fairly took one's breath to think of a telescope with an aperture of *thirty feet* and of what it might reveal. Many of us had been under the impression that Professor Ritchey was at this time actually engaged in the construction of a mirror having a diameter of over one hundred and forty inches. It was true that he had been commissioned by Mr. Dina—a gentleman of Indian birth and a British subject—to make a glass of such dimensions. Two years had been occupied in preliminary work in the laboratory of the Paris Observatory, since it had been found necessary to approach the larger apertures gradually—testing and proving each increasing size. At the time of our visit, no attempt had been made to construct a mirror larger than sixty inches. One thing that seemed to justify Professor Ritchey's faith in his ability to build huge mirrors—say thirty feet in diameter—was that he believed a surface disc might be made sectionally and cemented together strongly enough to admit of grinding and polishing and remain true.

From studying detailed plans and listening to verbal descriptions, I learned that the ultimate instrument was expected to be of the Cassegrainian type, involving two concave mirrors—a large and a small—each figured to the new Chrétian curves. It was believed that this combination would result in giving much greater concentration of light, with less dispersion of image, with star-discs over the entire field, smaller and brighter, than can now be obtained. Such an advantage in the photographic study of faint dense objects, such as clusters and nebulae, is obvious. The housing was to be a dome-topped, vertical structure, the light being directed down the central shaft by a pair of flats in the dome, as in the usual tower telescope. The primary mirror was to be near the base, with the secondary on a higher landing while the observer occupied an even-temperature chamber below the surface of the ground. Supplementary mirrors were to be held in reserve on horizontal tracks, at right angles to each other, on each of the two mirror levels, in order that new combinations might be introduced at will; the interchange to be effected electrically and require but a few minutes. Professor Ritchey stated that such an exchange, in present types, now re-

quired from one to one and a half hours. In reality such an instrument would be five telescopes in one. The great flats were of course to be of the new cellular type and Professor Ritchey remarked: "This style flat will *remain* flat."

One quickly sensed Professor Ritchey's ambition to approximate perfection in celestial photography as he discussed the three things, without which the proposed giant instrument, despite its great power and many refinements, could accomplish little over present results. The first of these is a site appropriate for such an instrument.

Professor Ritchey has given much thought to possible locations. Such a one, to be practicable, must, of course, be high, dry, and of even and, as far as possible, unvarying temperature, but still accessible to the rest of civilization. He stated his conviction that high altitudes in lower latitudes contiguous to the Pacific Ocean, more nearly fulfill these requirements than any other sections of which he knows.

He told of camping out for several days with Mrs. Ritchey on one auspicious spot and of testing the conditions that led him to decide upon its ideal fitness for the purpose.

How often he must dream of it, and in those dreams must build upon its glorious height such a heaven-searching instrument as only he can visualize.

His next consideration was the little three by three inch plate, whose sensitized emulsion is the only medium by means of which to express the power of a great glass, and which is such an important factor in the process of pulling down the sky. To be made available for study, its picture must be magnified perhaps twenty diameters—for hidden in its gelatine surface are the faint traces of what may be other universes, immeasurable. Just shadow specks that must be coaxed into visibility and form. How essential that the emulsion be of extreme smoothness, with the finest imaginable grain, plus a maximum of sensitiveness. Professor Ritchey expressed his faith that plates answering these conditions, though not now procurable, can and will be made.

Given the great, true, stable, glass, set in the choicest of positions and in as clear, tranquil, and undisturbed an atmosphere as possible—its yawning immensity spread to catch the least flicker of light from outer space—with the supersensitive, smooth-grained plate in position to do its highly important work; it is nevertheless bound to a swiftly-flying world—rather insignificant perhaps, but the only thing we have at hand upon which to plant a telescope. And round it all—ever interfering with the function of our great machine—is the swirling, waving, flowing, sea of our atmosphere, now hot, now cold, now damp, now dry, now clear, now obscure. If left to itself—even driven to follow the sky with the most delicate and accurate mechanism—the story that the sensitive plate would have to tell would be a sorry thing. For ever interposed between sky and plate is a flaunting, gyrating ghost of distortion—quiet for a fraction of a second only, then flitting and flickering

again. Never at rest—never quiescent. Surely only an unresting eye on the guiding star and a skilled hand, trained to react with lightning rapidity to the varying characters and degrees of disturbance, can cope with this inevitable condition. Professor Ritchey declared that the training for guiding should be as technical and thorough as that required by a pianist who aspires to become a virtuoso—the same untiring practice—the same co-ordination between brain and finger-tips—the utter concentration that alone can give the desired result. So exhausting is the process, according to Professor Ritchey, that a change of followers is demanded every fifteen minutes if the best results are to be obtained. The minuteness of star discs, the sharpness of delineations in nebular configurations or the brilliancy of details of planetary surfaces, would be in direct proportion to the skill and nerve and patience of the man who would undertake the highly important task of guiding a great telescope.

Leaving the observatory and passing out among the shadowed monuments that wierdly guarded the nearly deserted midnight streets of Paris, I looked above rows of trimmed trees to the familiar, peaceful, comforting, constellations. Imagination, fired by the ambition and enthusiasm of my recent host, was at white heat. Think of startling into action the dormant civilization on this little whirling sphere, by bringing back from limitless space more perfect pictures than had ever before been made, of those unknown universes whose existence we now vaguely sense. What an adventure it would be. What feat of terrestrial exploration could compare with it?

Because of the God-given craving for knowledge and truth inherent in the sons of men—it will be done. Sometime—somewhere, it is hoped, this perfectly equipped argosy will be launched and there will be a man whose wisdom and experience have made him worthy to guide it, standing resolutely at the wheel.

THE LUNAR ECLIPSES OF 1927.

By WILLARD J. FISHER.

There are to be two lunar eclipses in 1927, about the middle and end of the year. Some of their relations to the earth's atmosphere are as follows:

1927 June 15, the first eclipse is at its height (mid-eclipse) at $8^h\ 24^m.2$, Universal Time; but the moon barely gets within the umbra on the north side of the earth's shadow. The radius of the geometrical umbra is 40′.8; the outer limb of the moon at mid-eclipse is distant 40′.7 from mid-shadow. At this moment the edge of the shadow nearest to the moon's limb is cast by the earth's surface and atmosphere at about

W 97°.3, N 63°.75, in the neighborhood of Baker Lake, which drains into Chesterfield Inlet, on the west shore of Hudson Bay. It would be very interesting to know the weather, cloud, and sky conditions in this region at this moment. But the atlas indicates hardly any population there.

In the eclipse of 1892 November 4 the outer limb of the moon was 43′.0 from mid-shadow, the radius of the geometrical umbra was 45′.4, so that the immersion was deeper than in the coming case. But Gale, at Sydney, N. S. W., reported the limb so bright as to give the impression that the eclipse was not total; Russell, also at Sydney, said definitely that it was not total; Doberck, at Hong Kong, remarked on the brilliancy of the immersed limb. We may expect this time to observe the density of the earth's shadow very near to the edge, but due to weather and climate conditions very different from those which ruled in 1892. Then the grazing point was over water, between Iceland and Norway, north of the Shetland Islands.

The last rays on the moon's limb at first contact with the umbra graze the earth's surface or atmosphere about W 174°.7, N 32°.7. This is at sunset on the open Pacific, north of Pearl and Hermes. The rays at last contact in like manner graze about W 69°.1, N 17°.6, a point at sunrise in the Caribbean Sea, considerably south of Catalina Island, south of Santo Domingo. Observations of weather, cloud, and sky at these points are desired, for comparison with direct observations of the shadow edge at these moments.

The two internal contacts at this eclipse come so close together that they are hardly separable from mid-eclipse. At mid-eclipse the sunrise-sunset line, centered about the subsolar point at E 54°.0, N 23°.3, passes by Cape San Roque, Nova Scotia, Great Bear Lake, New Guinea, Gulf of Carpentaria and Enderby Land. Of all this great circle, however, only a fraction, perhaps 35°, on the two sides of the Baker Lake region, is effective in illuminating the eclipsed moon.

The second lunar eclipse, on December 8, with middle at $17^h\ 34^m.6$, Universal Time, is of much deeper immersion, 11′ or more at most, in the southern half of the shadow. The inner (north) limb of the moon just covers the middle of the shadow. The grazing light at the contacts comes from regions about the points indicated.

First Contact: E 41°.6, S 25°.7, in the Mozambique Channel, between Tullear and Europa Island, at sunset.

Second Contact: E 51°.0, S 51°.3, in the Sea Tang, south of the Crozets, at sunset.

Third Contact: E 164°.4, S 22°.0, southwest of New Caledonia, at sunrise.

Fourth Contact: E 157°.0, S 3°.5, northeast of Bougainville Island, at sunrise.

Observations of weather, cloud, and sky at these points are desired, for comparison with observations of the shadow edge at the contacts.

At mid-eclipse the sunrise-sunset line is centered about the subsolar point at W 85°.75, S 22°.7, and passes over or near Kaiser Wilhelm Land, Fiji Islands, Sitka, Timbuctoo, Mossamedes, Cape Town. The whole southern half of this great circle is effective in illuminating the eclipsed moon at this moment.

The mere naming of the grazing points above indicates that observations within a few degrees of them are unlikely to be obtained. Still, it is desired that persons near any such, at sea or ashore, report their observations of weather, cloud, and sky, at the sunrise or sunset moments indicated, either to some scientific journal or to the address, Lunar Eclipses, Harvard College Observatory, Cambridge, Mass., U. S. A.

ON THE ACCURATE ADJUSTMENT OF STATIONARY CORONAGRAPHS WITH DESPATCH.

By DAVID TODD.*

A note on the origin of the stationary coronagraph, wherein lens (or mirror) with its tube is rigidly mounted, while only slow-motion of plate and plate-holder compensate by clock-movement for the diurnal motion, is of especial interest because of its practically universal adoption by the most successful observers of recent total eclipses.

For the "Angola Expedition of Dec. 1889" (fitted out under the naval direction of the late Admirals John G. Walker, and George Dewey, U. S. Navy, successive Chiefs of the Bureau of Navigation), I was anxious to get large-scale pictures of the corona, because the very small photographs of the coronas of 1878 (July 29), and 1889 (Jan. 1) had unmistakably revealed for the first time a finely filamentous polar corona, suggesting a magnetic origin.

Dry plates were then very new in scientific photography; films barely dreamed of. My chief assistant on this expedition, the late Dr. Frank H. Bigelow, and myself devised a rather cumbrous type of mounting for a 40-ft. telescope. This had a "Hot-sand" clock with gravity drive; and its successful working was almost wholly due to his patience and ingenuity. For an objective we employed one of the 5-inch photographically-corrected Clark lenses, something over 40 feet in focal length, that had been used in photographing the transits of Venus in 1874 and 1882.

This huge eclipse instrument, awkward though it was, pointed the way to the next inventional step, most important of all: This was taken by the late Dr. Schaeberle of the Lick Observatory, who, on occasion of the Chile totality of April 1893, carried out the plan to a successful

*Professor Emeritus Astronomy and Navigation, Amherst College.

issue, being favored with perfect weather; while our *Pensacola* Expedition four years earlier in West Africa had been completely knocked out by a very small cloud, just a few times larger than the corona itself, and the only cloud in the whole sky all that day.

Schaeberle's reward was the largest and finest dry-plate pictures of the corona to date. And his great advance in instrumental coronagraphy has, with the growth in sensitivity of dry plate and film, led by direct evolution to the near-perfect photographic pictures of the corona by Campbell (1898, 1918, 1922), numerous American parties in 1925, and Miller and the U. S. Naval Observatory parties in Sumatra, 1926.

What Schaeberle did for the first time was to mount his objective rigidly on a pier, and so adjust it that the plane of the lens was normal to a line toward the sun at mid-totality. Parallel to the plane of the lens and in its focal plane, he mounted the plate-holder, in a mechanical slide parallel to the earth's equator. Then, as the sun's image was about 4.6 inches in diameter, it was easy to regulate the slide-motion so that the sun should "stand still" upon the slowly moving plate—thus introducing into literature for the second time the term "JOSHUA."

Then Schaeberle built his light-proof camera around the entire affair. And the lay of the land surrounding the Chilean copper mines of Copiapó favored him, as the tilt of the terrain was a little less than the sun's altitude at totality.

With nearly level ground at a station, it is only necessary to

(1) Calculate the sun's altitude and azimuth at mid-totality;

(2) Establish a meridian line (easiest done in the northern hemisphere by Polaris and ζ Ursae Majoris or δ Cassiopeiae, and checked by the magnetic needle, if its declination for the selected station is well known);

(3) Build a skeleton tower for rigid support of the objective;

(4) Mount the plate-holder so that the plate is in the focal plane;

(5) Collimate the objective on the center of the plate-holder;

(6) Collimate the center of the plate-holder on the center of the objective;

(7) Adjust the slide of the plate-holder parallel to the diurnal motion.

All this is easy to do in a week's time at the station. But as eclipsers cannot always be fortunate in arriving with that degree of leisurely leeway, I have worked out (as an evolution of nearly a dozen expeditions) a method which secures perfect adjustment of coronagraphs, whether stationary or clock-driven, in a minimum of time.

This I employed successfully for the first time on my Russian Expedition of 1914, located (by the very courteous invitation of Count A. Bobrinsky) on his vast estates of the pre-war era near Smela, southward from Kiev toward Odessa.

All one needs is (1) the longitude of the station, (2) the sun's hour angle at mid-totality, (3) a corrected chronometer (preferably sider-

eal), and (4) the right ascensions of several lucid stars whose declination is nearly that of the sun at mid-totality, and which are within a few hours of the sun (of greater right ascension than the sun, if totality happens in local afternoon, less if in the forenoon), and (5) the focal length of the objective.

If the star is a fairly bright one, and the sky cloudless, a single observation of it the night preceding totality is quite sufficient to fix the orientation of the camera with all needful precision. Once its true direction is established, it is easy to collimate both objective and plate very exactly. Or if the camera is a lesser one, with separate clock-motion, an adjusted optical finder will provide its true orientation by a single pointing on the star, at the critical instant when its H equals that of the sun at mid-totality.

At the instant when the corrected chronometer-time shows that the star's hour-angle is equal to that of the sun at mid-totality, fix the plate-holder rigidly in its final position, with the star at the meridian line passing through the center of the plate.

As the declination of the star selected will rarely be the same as that of the sun at totality, a corresponding allowance for this difference of declination must be made, N or S, in the plate-field. Both RA and δ adjustments will then be perfectly made by a single pointing.

By beginning 10 or 15 minutes earlier, and inserting in the plate-holder a clear glass plate or film with a dark E and W line finely drawn upon it, the true position-angle adjustment of the plate-holder slide is easily made by fixing it finally in that position where the star in its diurnal motion travels exactly parallel to this plate-line.

Totalities vary greatly in availability of equi-declination stars for this purpose. Sometimes, especially with near-solstitial eclipses, a bright planet will conveniently help out, by having the same declination as the sun's and being at the same time far enough east or west of the sun so that twilight does not interfere with its visibility.

I have selected from the time-star list of the *American Ephemeris and Nautical Almanac* for 1927 and 1928 the following stars that will be helpful in the way indicated, on occasion of the next two total eclipses of the sun. They are as follows:

For Totality of 1927, June 29.
(45^s Duration near North Cape.)
Stars Preceding ☉ Forenoon Stations in England, Norway, Sweden.

Name	Mag.	Apparent R.A. h m s	Apparent Decl. ° ′ ″	
λ Pegasi	4.1	22 43 2	+23 10 49	
μ Pegasi	3.7	22 46 30	24 12 53	
τ Pegasi	4.6	23 17 2	23 20 22	
υ Pegasi	4.6	23 21 45	23 0 3	
ζ Andromedae	4.3	0 43 28	23 52 9	
α Arietis	2.2	2 3 3	23 7 1	Best Star
η Tauri (Alcyone)	3.0	3 43 8	23 52 47	
☉	−26.0	6 28 25	+23 17 17	

Stars Following ⊙ Afternoon Stations in Northeast Siberia.

		h m s	° ′ ″	
γ Cancri	4.7	8 39 3	+21 43 59	
ε Leonis	3.1	9 41 42	24 6 44	
ζ Leonis	3.6	10 12 38	23 46 59	Best Star
41 Leo. Min.	5.0	10 39 27	23 34 21	
β Herculis	2.8	16 27 6	+21 38 55	

For Totality of 1929, May 9.

(5^m Duration in Northern Sumatra, Penang, So. Cambodia, Panay, Leyte.)*

Name	Mag.	Apparent R.A. h m	Apparent Decl. ° ′	
⊙	−26.0	3 2	+17 10	
δ Tauri	3.9	4 19	17 23	
α Tauri (Aldbrn.)	1.1	4 32	16 22	
γ Geminorum	1.9	6 34	16 27	
λ Geminorum	3.6	7 14	16 40	
ξ′ Cancri	4.7	8 8	17 52	
η Leonis	3.6	10 3	17 7	Best Star
τ Bootis	4.5	13 44	17 49	
κ Herculis	5.3	16 5	17 14	
β Sagittae	4.4	19 38	+17 19	

Another and salient advantage of this star-method I found very helpful in 1914, and reported in *Nature* (Oct. 29, 1914, p. 232). Leaving one of the corona plates undisturbed in the identical position where it was exposed for totality, one of the equi-declination stars was allowed to trail across the plate, its exposures being timed for the preceding and following edges of the photographic field. These interrupted star-trails were then developed with the coronal image itself, thus providing perfect orientation for prominences, sharply defined coronal streamers and the sun's (apparent) magnetic poles.

I have pleasure in acknowledging the courtesy of Captain Edwin T. Pollock, U. S. Navy, Superintendent Naval Observatory, for communicating in advance of publication the co-ordinates of the track of total eclipse, 1929, May 9th. All the forenoon stretch of this totality path is lost on the Southern Indian Ocean; but there are many excellent stations along the line above indicated. The width of the belt of total eclipse is about 115 miles.

*Consult Popular Astronomy, April, 1927, pp. 214-8, for full data *re* accessibility of stations in the "thickly populated islands of the Philippines, like Cuyo, Panay, Negros, Cebu, Bohol Leyte, Samar, and Dinagat," with critical estimates of weather chances thereat, by Professor Miguel Selga, the very efficient Director Philippine Weather Bureau, Manila.

NEWTON'S WORK IN ASTRONOMY.

By SIR FRANK DYSON, K. B. E., F. R. S.

[*In the issue for February (p. 130) mention was made of the plans for commemorating the two-hundredth anniversary of the death of Sir Isaac Newton. The exercises were held at Grantham on March 18-20, 1927, under the auspices of the Yorkshire Branch of the British Mathematical Association. In the* Supplement to NATURE, March 26, 1927, *a number of the addresses, delivered on that occasion, and the special sermon by The Lord Bishop of Birmingham are published. Through the courtesy of the Editor of* NATURE *we have permission to reprint the address by Sir Frank Dyson, Astronomer Royal of England, which is the one of especial interest to astronomers.* ED.]

Writing in the year 1738, Voltaire narrates that Madame Conduitt, Newton's niece, had related to him that in the year 1666, Newton, seeing an apple fall in the garden of Woolsthorpe, meditated profoundly on the cause which draws all bodies in a line which, if produced, would pass through the centre of the earth. Voltaire then tries to reconstruct the line of thought which led Newton to the law of universal gravitation. Would it act if the apple were a mile high or ten miles high? If so, might it not act so far away as the moon, and this power, whatever it is, be the same as that which keeps the moon in its orbit round the earth, the planets moving round the sun, and its satellites round Jupiter?

Vague ideas were current as to the forces which kept the planets in their orbits. Descartes put forward a theory of vortices in a fluid medium diffused through space. This gave a possible sort of mechanism suggested by water or air whirling on the earth, but the details could not be fitted to agree with the known facts of astronomy. Kepler had suggested an attraction between the planets varying as the inverse square of the distance and had afterwards substituted the inverse distance. Others before Newton may have suggested the inverse square, but were unable to carry the idea further. Newton was able to bring the hypothesis to the stage at which it could be tested by its agreement with phenomena. Assuming that the force by which the earth attracted outside bodies varied inversely as the square of the distance and at the earth's surface caused a body to fall 16 feet in one second, he calculated that, as the moon is sixty times as distant from the centre of the earth, the attractive force of the earth at that distance would pull the moon inwards towards the earth 16 feet in one minute. He then calculated the actual force necessary to keep the moon moving round the earth in 27 days 7 hours at a distance of sixty times the radius of the earth. It is said, but without much evidence, that Newton used the erroneous value of 60 miles for 1° of latitude of the earth's surface employed by mariners to calculate the earth's radius, and was unacquainted with the more accurate measures of Norwood in 1636, which made 1° of latitude 70 miles. He thus obtained a value one-seventh part too small, and in view

of this discrepancy for a time turned his thoughts to other things. He may have returned to the subject a few years later when he became acquainted with the results of Picart's triangulation from Paris to Amiens made in 1669-1670.

Though we do not know the precise date when Newton had satisfied himself of the truth of the law of gravitation, in 1684 it was complete, and he could not only demonstrate to Halley that under a law of the inverse square planets would describe ellipses round the sun, but could also promise to send to the Royal Society the mathematical principles of natural philosophy in which the doctrine of universal gravitation is set forth in order and its manifold consequences deduced.

In Book III. of the "Principia" Newton begins with the astronomical evidence. The four satellites of Jupiter describe equal areas about Jupiter in equal times; and the squares of their periodic times are proportional to the cubes of their distances from Jupiter's centre. The same is true of the satellites of Saturn. The same holds for the motion of the planets round the sun. The moon, too, if the small disturbances caused by the sun are neglected, describes equal areas in equal times about the earth's centre. It follows from the mathematical demonstration in Book I. that the forces which kept Jupiter's satellites in their orbit tend to Jupiter's centre and are inversely as the square of the distances of the satellites from that centre. The same applies to Saturn and its satellites. The movement of the planets round the sun are known to obey these laws of Kepler's with very great accuracy. Consequently this law of the inverse square holds with equal accuracy. The moon, however, does not move accurately in an ellipse, as its apse shifts 3° in each revolution, but this is to be explained by the disturbing action of the sun; but making allowance for this, the force attracting the moon to the earth varies according to the same law of the inverse square of the distance. With the accurate distance of the moon from the earth's centre, the distance it is drawn towards the earth in one minute is calculated, and thus the amount of the earth's attraction at the moon's distance is found. This will be increased 60^2 times at the earth's surface. It is then found to agree exactly with the force which causes bodies to fall at the earth's surface. Thus the force which retains the moon in its orbit is at the earth's surface identical with the well-known property of weight or gravity.

It is, then, gravity which keeps the planets and satellites in their orbits, and all gravitate mutually towards one another, with forces which vary inversely as the square of the distance between their centres. Newton now investigates whether he can detect any differences in the gravity of different substances. He provided two wooden boxes round and equal; filled one with wood, and suspended an equal weight of gold in the centre of oscillation of the other. The boxes hanging by equal threads of 11 feet, made a couple of pendulums perfectly equal in weight and figure and equally receiving the resistance of the air. In

this way he found that the force of gravity is within 1/1000th part the same for gold, silver, lead, glass, sand, common salt, wood, water, and wheat. That is, if the resistance of the air were absent, all those bodies would fall at the same rate.

Newton shows point by point that gravity is a universal property of all bodies, dependent solely on the amount of matter they contain. This must hold for the planets, and every part of each planet must gravitate to every part of any other planet, and finally every particle of matter attracts every other particle with a force proportional to the product of their masses and inversely proportional to the squares of the distance between them. He then shows that two uniform spheres will attract one another as if their masses were concentrated at their centres. This is perhaps the most splendid piece of geometry ever achieved. It appears to have cost Newton a great deal of thought. He says:

"After I had found that the force of Gravity towards a whole planet did arise from and was compounded of the forces of gravity towards all its parts, and towards every one part was in the reciprocal proportion of the squares of the distances from the part, I was yet in doubt whether that reciprocal duplicate proportion did accurately hold or but nearly so, in the total force compounded of so many partial ones; for it might be that the proportion which accurately enough took place in greater distances should be wide of the truth near the surface of the planet, when the distances of the particles are unequal and their situation dissimilar. But by the help of prop. 75 and 76, Book I., and their corollaries, I was at last satisfied of the truth of the proposition as it now lies before us."

The results which follow from the law of gravitation set down in its generality are almost magical. The laws of the movements of the planets round the sun and satellites round the planets follow immediately. Comparison of the dimensions and rate of description of the orbits give the comparative masses of the sun, earth, Jupiter, and Saturn. The sun is 1060 times as massive as Jupiter and 270,000 times (with the parallax Newton used) as massive as the earth. Thus the earth is found to have a mean density of four times that of the sun, and Newton hazards the guess that the earth's density is between five and six times that of water. The effect of the mutual action of the planets on one another is indicated, and the disturbing action of the sun on the moon is shown to give rise to the revolution of the apse and node, the variation and other inequalities of the moon's orbit. The inequalities known to astronomers were explained and new ones predicted. This complicated problem was carried so far as possible by geometrical methods. Newton said he should give up thinking about the moon, for it made his head ache.

The figure of the earth is next shown to be a spheroid. Owing to rotation the equatorial diameters of planets must be greater than their polar diameters. Observation showed that this was true in the case of

Jupiter, which revolves very rapidly in 9 hours 50 minutes. By considering the equilibrium of water in two channels from the pole and a point on the equator to the centre of the earth, Newton showed that the equatorial diameter of the earth would be 1/230th part greater than the polar diameter. Assuming a spheroidal form for the earth, he calculated the length of a degree in different latitudes, and the length of a pendulum beating seconds. He compared these with observations made in various places, such as Paris, Cayenne, St. Helena. This investigation served as a great stimulus and provided a theoretical basis for the more accurate determination of the size and figure of the earth.

The general explanation of the tides was a further deduction from the law of gravitation. Newton showed that the attraction of the moon gave rise to forces tending to heap up the water at a point of the ocean directly under the moon and also at the antipodal point; similarly the sun's attraction tended to cause high water directly under the sun and at the antipodal point. He showed how the spring and neap tides would occur, how the position of the sun or moon, north or south of the equator, would affect the tides and how they would vary in different latitudes. By comparing the heights of the spring and neap tides he concluded that the tide-raising force of the moon was 4.48 times that of the sun. Knowing the mass of the sun he finds it should raise a tide of 1 ft. 11 in. in the open sea, and infers for the moon one of 8 ft. 8 in. Newton gave only an elementary theory of the tides, indicating the causes which produced their main features, and left to his successors the difficult problem of a dynamical theory.

Just as the moon produces tides on the earth, so the earth would produce tides on the moon. As the period of revolution of the moon is the same as its period of rotation on its axis, the moon always presents the same face to us. If the moon were covered with water, the water would be heaped up at the part facing the earth and the part diametrically opposite. So Newton infers that the moon has a spheroidal figure, the longer axis pointing to the earth, and being 186 feet in excess of the equatorial diameter.

The precession of the equinoxes is explained as due to the attraction of the sun and moon on the spheroidal part of the earth. Newton had shown how the attraction of the sun on the moon produced a movement of the nodes of the moon's orbit. In other words, a line drawn perpendicular to the plane in which the moon is moving will trace out a cone in 18½ years. He deduced what would be the movement of the nodes of the orbit of a little moon near the earth's surface, revolving in a sidereal day. The same thing would happen, he says, to a ring of moons, whether they did not eventually touch each other or whether they were molten and formed a continuous ring. Next let the ring of moons be attached to the sphere and communicate its motion. Thus the axis of a mass composed of the ring and sphere together will have movement due to the sun of 9″ annually, and the effect of the moon is

in the proportion of the tide-raising force of the two bodies. Airy remarks: "If at this time we might presume to select the part of the 'Principia' which probably astonished and delighted and satisfied its readers more than any other, we should fix, without hesitation, on the explanation of the precession of the equinoxes."

A good deal of space in Book III. is given to comets. Tycho Brahe had shown that they moved in the celestial spaces and did not belong to our atmosphere. Newton regarded them as bodies like the planets, but moving in very elliptic, nearly parabolic orbits, and showed how from three observations their paths might be determined. The tails arise from the atmosphere of the heads, their great length and splendour being due to the heat which the sun communicates to the comet when near to it. He notes that the perihelion distance of some comets is very small, that of 1680 being only one-sixth of the sun's diameter from the sun's surface. Owing to resistance it is possible they may, in course of time, fall into the sun. He hazards the suggestion that fixed stars may be recruited by the fall of comets into them, and here may be a possible explanation of the new stars which have appeared from time to time.

There are two other contributions of Newton to astronomy to which I should like to make a brief reference. In the "System of the World," a work which Newton intended at one time to form Book III. of the "Principia," there is a little-known estimate of the distance of the fixed stars. As it was one hundred years before any better estimate was obtained, I venture to direct attention to it.* The disc of Saturn, Newton says, is 17″ or 18″ in diameter. It receives 1/2,100,000,000th of the sun's light. If we suppose Saturn to reflect ¼ of the light it receives, the whole light reflected from its illuminated hemisphere will be 1/4,200,000,000th of the light emitted from the sun's hemisphere. If the sun were $10{,}000\sqrt{42}$ times more distant than Saturn, it would yet appear as lucid as Saturn now does without its ring. Let us, therefore, suppose that the distance from which the sun would shine as a fixed star to exceed that of Saturn by about 100,000 times. This gives 0″.2 as the annual parallax of a first magnitude star and 0″.002 as its diameter. Newton answers the objection that light may be absorbed in its passage through space, for in that case the remoter stars would scarcely be seen.

We may also recall the fact that Newton was the first person who actually constructed a reflecting telescope. He gives an account in the *Phil. Trans. Roy. Soc.* of the chemical experiments he made for the best composition of speculum metal. The use of pads of pitch on which rouge is spread for polishing mirrors and lenses was invented by him. I believe instrument-makers have found no better materials since.

Returning to Book III. of the "Principia," nowhere has so much been comprehended in so few words as in the law of gravitation. It does not explain to us why the moon and planets move as they do, but

*Schlesinger, *Publ. Astr. Soc. Pacific*, vol. 14, p. 170.

it does show us how they move and enable us to calculate their movements. Generations of mathematicians and astronomers have employed large parts of their lives in tracing its consequences in most intricate details, comparing the results with observations, and discerning the past and future history of the solar system. Laplace, perhaps the most illustrious of Newton's followers, says "the number and generality of Newton's discoveries relative to the system of the world, the multitude of original and profound views, which have been the germ of the most brilliant theories of the geometers of the last century, will assure to the 'Principia' a pre-eminence above all other productions of the human intellect."

THE COMING APPROACH OF COMET PONS-WINNECKE.

By G. VAN BIESBROECK.

Much interest has been aroused by the announcement that this year the periodic comet Pons-Winnecke will come nearer to the earth than it has ever done since it was first discovered in 1819 by Pons at Mar-

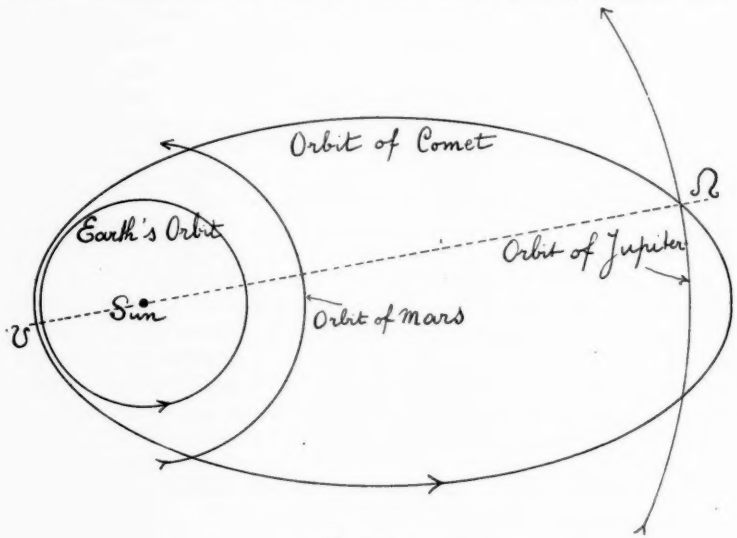


FIGURE 1.
ORBIT OF COMET PONS-WINNECKE.

seilles (France). In order to illustrate the circumstances of this approach I have represented in Figure 1 the present orbit of the comet. The plane of that orbit makes an angle of 19° with the ecliptic but the curve has been projected on the latter. The nearly circular orbits of the

earth, of Mars and of Jupiter are also represented. At minimum distance from the sun the orbit of the comet is quite close to the earth, while at its maximum distance it goes beyond the orbit of Jupiter. The period is very nearly 6 years at present as against 12 years for Jupiter. Every two revolutions this massive planet introduces larger perturbations in the motion of the comet. In 1921 the path of the comet came nearer to the earth than this year, but the comet itself had already passed by 9 days the point of minimum distance between the orbits when the earth reached that place. This year the orbit is somewhat farther from the earth, but by a rare coincidence both earth and comet will be simultaneously at the critical points, thus bringing the two bodies within a distance of only 5½ million kilometers (3½ million miles) or about 15 times the mean distance of the moon. This is illus-

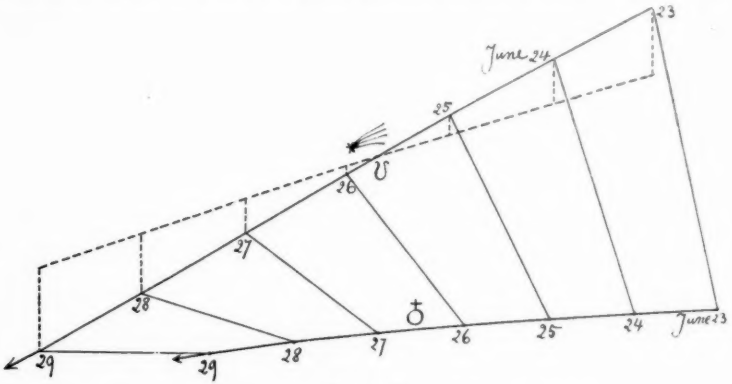


FIGURE 2.
COMET PONS-WINNECKE IN RELATION TO THE EARTH.

trated by Figure 2 representing the positions of the earth and the comet from day to day between June 23 and June 29. The lower curve represents a portion of the orbit of the earth, the upper the successive positions of the comet. The corresponding points have been connected so as to show the change in distance and direction. The dotted curve represents the projection of the orbit of the comet on the plane of the earth's orbit. Up to June 25.6 the comet is north of the ecliptic by the amount indicated by the short lines connecting the orbit of the comet and its projection. At that moment it passes the descending node and afterwards moves rapidly southward. The minimum distance corresponds to June 27, but the separation does not change much for a couple of days before and after that date, since both comet and earth travel in the same direction around the sun. It is a curious coincidence that this date corresponds to the time of the total eclipse of the sun, the path of which crosses England and Scandinavia.

The uncommon occurrence of a celestial visitor coming relatively so

close to the earth will however not be marked by any exceptional phenomena, as far as the inhabitants of the earth are concerned! They will not notice the effects of the approach any more than they did in 1770 when Lexell's comet passed at half the distance from the earth. It should be remembered also, that Pons-Winnecke's comet is intrinsically an inconspicuous and inactive member of the solar system. It is always described as a diffuse nebulous object, with a small central nucleus. At none of its previous returns has it shown any tail. The development of such an appendage depends for a given comet mainly on the distance to the sun, the action of which evidently produces it. At this return the comet is not any nearer the sun than previously, so that nothing like the spectacular sight of the long tail of the September comet of 1882, nor the long tail attending Halley's comet in 1910 can be expected. The closer approach to the earth will only make the object apparently larger in size and brighter than at previous occasions. But there is no question of the earth passing through the gaseous envelope of the comet and less of its passing through the tail. The comet is farther from the sun than the earth, so that even if the nebulosity surrounding the nucleus were dissymetrical so as to suggest a tendency to the formation of a tail, the latter would be pointing away from the earth. In 1921 the maximum total brightness was estimated by various observers as between 8^M and 9^M, and the central nucleus as 11^M or 12^M; the extent of the nebulosity surrounding the nucleus as measured on a plate taken with the Bruce telescope and exposed for 4^h by Barnard on June 5, 1921, is 13′. This time the relations of distances are such that the comet will appear 3 magnitudes brighter and 4 times larger in size. We can therefore expect just naked eye visibility, but the object will be visible only as an extended diffuse nebula, possibly 1° in diameter, moving rapidly southward across the summer constellations of Lyra, Cygnus, Vulpecula, Delphinus, Equuleus, and Aquarius, between June 22 and July 1. The positions can be found by means of the ephemeris given on page 284. In July it will soon be lost for observers in the northern hemisphere.

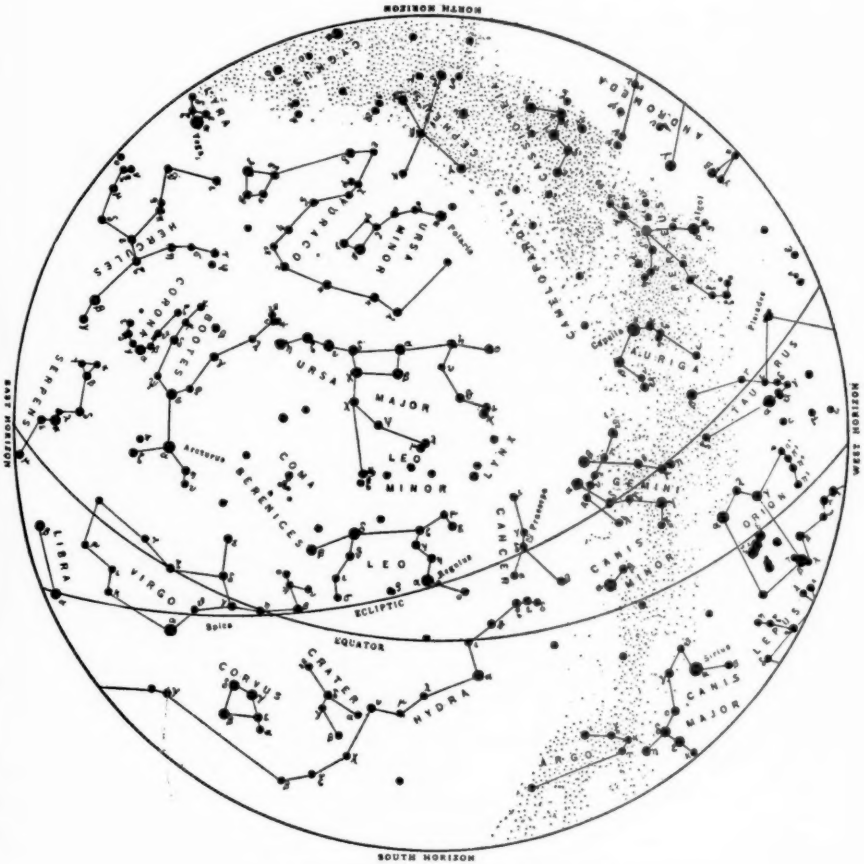
During the last days of June the parallax of the comet will reach nearly 4′ and it has been suggested that this might give an opportunity of determining the solar parallax with great accuracy. It is questionable, however, if the object will be well enough defined to lend itself to measurements of high precision.

The close approach of the earth to the path of the comet may produce some meteoric activity; except for some meteors seen in 1921 observers were generally disappointed in their expectation of an active display of shooting stars, although at that time the earth came nearer to the *orbit* of the comet than it will this year. It will, however, be of interest to watch the sky at the end of June for a possible meteoric display. Last quarter comes on June 22 so that there will not be much interference from the moon.

PLANET NOTES FOR JUNE.

By CLIFFORD E. SMITH.

The *Sun* will be moving northeast in Taurus until the time of the summer solstice on June 22. At this time the sun will cross over into Gemini, and it will



THE CONSTELLATIONS AT 9:00 P.M. JUNE 1.

start its six months' journey southeast. On June 29 a total eclipse of the sun will occur, which will be visible in England and Norway, but not in the United States. The position of the sun on the first day and last day of the month will be respectively: R.A. $4^h\ 31^m$, Decl. $+21°\ 53'$, and R.A. $6^h\ 31^m$, Decl. $+23°\ 15'$.

The phases of the *Moon* will occur as follows:

First Quarter	June 7 at	2 A.M.	C.S.T.
Full Moon	15 "	2 A.M.	"
Last Quarter	22 "	4 A.M.	"
New Moon	29 "	1 A.M.	"

The moon will be at apogee (farthest from the earth) on June 9, and at perigee (nearest the earth) on June 24.

Mercury will be visible for an hour or more after sunset during June. Early in the month it will cross into the constellation Gemini. On June 22 it will reach a point of greatest elongation east of the sun. At that time it will be some six degrees south of Pollux (β Geminorum) and it will then set about two hours after the sun.

Venus will be about four degrees south of Pollux on the first of the month. During the middle of the month Venus will cross Cancer, and at the end of the month it will be in Leo. At the end of the month it will be about six degrees west of Regulus and it will set about three hours after the sun. On June 9, Venus will be in conjunction with Mars. The two planets will be about twice the diameter of the moon apart.

Mars, during June, will be in Cancer. During this month Mars will not be near any bright stars. About the fifteenth it will set approximately two hours after the sun. As has been mentioned under the discussion of Venus, Mars and Venus will be in conjunction on June 9.

Jupiter will be in the south central part of Pisces. Since it will be in quadrature, 90° west of the sun, on June 24, it will be near the meridian (the line due north and south through the zenith) at sunrise during the latter part of the month.

Saturn will be in Scorpius about six degrees west and north of Antares. It will be remembered that opposition will occur late in May, so Saturn will just be rising in the east at sunset on the first of the month. It will be visible most of the hours of the night.

Uranus will be in Pisces about two degrees east of Jupiter. Jupiter and Uranus will be on the eastern horizon about midnight late in the month.

Neptune will be in Leo about four degrees west of Regulus (α Leonis). At the middle of the month it will set about four hours after the sun.

THE SKY FOR JUNE.

(9 P.M., JUNE 15, LATITUDE 45° N.)

By CLIFFORD E. SMITH.

The evening sky for June will be very interesting as Venus will be the evening star. At nine o'clock it will be about ten degrees above the horizon. As one faces west Castor and Pollux (α and β Geminorum) will be seen a few degrees to the right of Venus. About the same distance to the left and higher in the sky will be Regulus, the bright star in the end of the handle of the sickle in Leo. The sickle will be the only striking configuration of stars in the western sky. It will be noticed that the stars of this group extend toward the pole star from Regulus, the blade of the sickle pointing toward Venus.

Facing south, Arcturus, the bright red star in Bootes, will be seen some

twenty degrees from the zenith. To the left and higher will be the fainter bluish star α Coronae. Below Arcturus, toward the west of south will be Spica (α Virginis). Lower in the sky and somewhat west of Spica will be the constellation Corvus, a group of four stars equally bright, forming an odd-shaped four-sided figure varying from two to four degrees on a side. On the opposite side of the meridian (the line through the north star directly north and south) from Corvus will be the bright red star in Scorpius, Antares.

Turning now toward the east, Altair (α Aquilae) will be seen near the horizon. Looking higher (at an altitude of about forty-five degrees) one will see Vega, a bright bluish star in the constellation Lyra. Below Vega and to the left will be a somewhat fainter blue star Deneb, the star in the head of the swan of the constellation Cygnus.

Finally, turning toward the north, one will see the constellation Cassiopeia low in the sky. This constellation is a group of five stars of about the same magnitude which at the time indicated will appear as a large W. Opposite Cassiopeia, in the northwest, Capella (α Aurigae) will be seen near the horizon. Directly above Capella, almost in the zenith will be the Big Dipper.

COMET NOTES.

By G. VAN BIESBROECK.

Comet 1927 *e* (Grigg-Skjellerup).

Since last month one more periodic comet has become visible. It is the expected comet Grigg-Skjellerup. Its reappearance was first detected by the British astronomers F. J. Hargreaves and G. Merton on a pair of plates exposed by the former. He used an aeroplane-lens of 20-inch focus working at a ratio of 1 to 5½; and made on March 27 two exposures of one hour centered on the position indicated by Merton's computations. On examining the plates, the latter noticed a suspicious nebulosity very close to the predicted place. In the words of the discoverer "the faint blurs in identical positions on the two plates were seen . . . with the naked eye or using a small magnification, but disappeared when magnified appreciably . . . As there seemed to be sufficient evidence to ask for confirmation I wired to Copenhagen. The magnitude stated (12) was a guess of the *integrated* light, allowing 3 magnitudes for the irregular area (diameter ±4′) over which the image was spread. Two further plates, March 28.8 (Hargreaves, Exposure 1½ hr.) though not entirely satisfactory, tend to confirm the reality of the object and give the correct daily motion. It is admitted that *all* the images are *very* elusive and that therefore further confirmation is required."

On March 28 the rough position

Mar. 27.86 $5^h\,47^m\,0^s$ $-4°\,0'$

was communicated to a few observatories with the remark "Please confirm." The writer had taken here a pair of plates with the 24-inch reflector on March 28.07, some five hours later than the English astronomers, but had not noticed the object on them. I was quite certain that no object as bright as 12^M could have been missed on the plates. Upon receipt of the telegraphic request, the plates were carefully examined once more, and this time a very faint nebulous blur was noticed, the motion of which corresponded to that of the comet. The integrated

light was, however, estimated as of magnitude 15.5, and I had some doubt if this was the same object that the English astronomers called as bright as 12^M. Awaiting an opportunity to repeat the exposures under good conditions, the following reply was telegraphed to the Harvard College Observatory: "No object brighter than 15^M in ephemeris position."

On March 30, further exposures were secured and this time the comet showed a much better defined appearance; instead of the indefinite hazy spot recorded on March 28, there was this time a round nebulosity 40″ in diameter, condensing in the center into a sharp nucleus of magnitude 16. The integrated light was estimated as 15^M. The plates had been guided for the motion of the object. The larger diameter given by the first observers is evidently due to the motion of the object which amounted to about 4′ per hour.

Measurement of the best plates on March 27 and 30 (Civil) gave the following accurate positions:

March 28.06826 U.T.	$5^h\ 47^m\ 17^s.12$	$-3°\ 55'\ 43''.5$
31.07419	5 50 48.38	−3 7 30.0

The second position was circulated through the Harvard College Observatory, and as the previous announcement had not been transmitted to all observatories, the erroneous assumption was made in some quarters that the comet was first picked up here. (See note by the editors on p. 245.) Full credit for the discovery should be left with the British astronomers, especially on account of Merton's splendid achievement in predicting the position. The first observations indicate for the perihelion time May 10.245, while the date predicted by his investigation, just printed in the *Memoirs of the Royal Astronomical Society*, Vol. 64, p. 47 (1927), is May 10.441, a deviation of but $4^h\ 40^m$.

The object has now been observed also in Bergedorf and Pino Torinese, but there is some doubt about a suspected image recorded in Uccle as early as March 21. An examination of the earlier plates taken here reveals a faint indication on those exposed March 5, but the images are too vague for measurement.

The extraordinary discrepancy in the estimated brightness is evidently due to the arbitrary allowance of 3^M for the area over which the image was spread. On the good plates secured here on March 31.07, a careful estimate of the integrated brightness, obtained by examining the plates with the naked eye at arm's distance, made the comet hardly brighter than 15^M on the scale of the Polar Sequence. Stars of magnitude 12 appeared enormously brighter than the total light of the comet. In fact if the limiting magnitude of the plate had been 12, or even 13^M, no trace of the comet would have appeared.

It will be remembered that this comet was first discovered in 1901 by Grigg in New Zealand. Its elliptic orbit was soon recognized but the short time of observation (June 22 to Aug. 3) and the rough character of the observations precluded an accurate determination of the period. The comet was not seen at later returns until it was independently picked up by Skjellerup on May 16, 1922, in South Africa.

The laborious task of connecting the two returns and taking into account the planetary perturbations was accomplished by G. Merton, who thus was enabled to make his fine prediction after the object has been out of sight for five years. In a letter of April 5, he communicates the following elements and ephemeris, which will require only slight modifications, when more accurate observations are available:

PROVISIONAL ELEMENTS OF COMET GRIGG-SKJELLERUP.

Time of Periastron (U.T.)	T	= 1927 May 10.245
Periastron minus node	ω	= 355° 2′ 22″.5
Longitude of node	☊	= 215 32 1.8 (1927)
Inclination	i	= 17 29 18.1 (1927)
Eccentricity	e	= 0.694211
Mean daily motion	n	= 711″.456
Semi-major axis	Log. a	= 0.465239
Perihelion distance	Log. q	= 9.950661
Period in years		= 4.98722

1927 0^h U.T.	α h m s	δ ° ′	Log. r	Log. Δ	Mag.
April 28	6 41 28	+ 7 59.0	9.9598	9.6201	12.7
30	46 25	9 16.2			
May 2	51 36	10 40.5	9.9549	9.5841	12.5
4	6 57 4	12 12.6			
6	7 2 51	13 53.8	9.9518	9.5453	12.3
8	8 58	15 45.1			
10	15 29	17 47.7	9.9507	9.5038	12.1
12	22 29	20 3.2			
14	30 6	22 32.2	9.9515	9.4604	11.9
16	38 28	25 16.3			
18	47 43	28 16.5	9.9544	9.4168	11.7
20	7 58 5	31 33.2			
22	8 9 53	35 6.3	9.9591	9.3757	11.5
24	23 34	38 54.2			
26	39 39	42 54.1	9.9656	9.3409	11.3
28	8 58 49	47 0.4			
30	9 21 55	51 6.1	9.9736	9.3171	11.3
June 1	9 50 2	55 0.4			
3	10 24 5	58 30.0	9.9829	9.3080	11.3
5	11 4 34	61 20.5			
7	11 50 37	63 17.8	9.9933	9.3149	11.3
9	12 39 31	64 12.9			
11	13 27 21	64 6.6	0.0046	9.3357	11.5
13	14 10 37	63 8.6			
15	14 47 35	61 33.1	0.0166	9.3664	11.7
17	15 18 5	59 34.1			
19	15 42 56	57 22.5	0.0290	9.4029	12.0
21	16 3 6	55 5.5			
23	16 19 36	+52 48.0	0.0418	9.4422	12.2

I have added the column of computed magnitudes under the assumption April 22 = 13^M according to the most recent observations here.

As the comet approaches perihelion in May, an increase in brightness greater than the ephemeris indicates is to be expected, yet the brightness will very likely stay much below naked-eye visibility. The conditions of observation will be excellent. The comet crosses the constellation of Gemini and Lynx in May, enters Ursa Major in June, passes near α Ursae Majoris on June 5 at the time of minimum distance to the earth (19 million miles) and moves rapidly eastward across the constellation of Draco. In June the northern declination reaches as high as 64° so that the object will stay above the horizon all night.

A correction to the statement on page 175 is necessary: contrarily to what was printed there the elements used by F. E. Seagrave in computing the search ephemeris given on that page have not been deduced independently by him. He has used part of the results of Merton's work (especially T) obtained from the latter by correspondence.

Of the three previously announced comets now visible, further observations were obtained in various places.

a) Comet 1927 *c* (Pons-Winnecke). This object is slowly brightening up. In a 4-inch finder the object was faintly visible as a diffuse nebulosity some 4′ in diameter on April 22. Its brightness at that time was therefore about 12M.5. The nucleus was small, although not stellar, and the brightest part of the coma surrounding it was only 15″ in diameter.

G. Merton has located an image of this object on a plate taken with the 30-inch reflector of the Greenwich Observatory on Feb. 25, two days before it was announced by the writer. This will therefore be the earliest observation at the present return.

With the use of the first observations of this year, A. C. Crommelin has given the following elements adopted from Merfield's work and after correcting the mean motion (*British Astronomical Association Circular* 51):

Elements of Comet Pons-Winnecke.

Time of perihelion	T =	1927 June 21.1564 U.T.
Perihelion minus node	ω =	170° 22′ 50″.0 } 1927.0
Longitude of node	Ω =	98 10 0.0 } 1927.0
Inclination	i =	18 57 0.0 } 1927.0
Eccentricity	e =	0.685515
	Log. a =	0.519242
	Log. q =	0.016840
Period in years	=	6.00983

From these the writer has computed the following ephemeris which covers the critical time of the nearest approach on June 27. The magnitudes were calculated by taking 12M.0 for April 30 which would nearly correspond to the estimation on April 22 mentioned above.

Ephemeris of Periodic Comet Pons-Winnecke.

1927 0h U.T.	α h m s	δ ° ′ ″	Log. Δ	Log. r	Mag.
April 30	14 57 16	+48 13.1	9.629	0.100	12.0
May 4	14 59 1	49 27.9			
8	15 0 58	50 35.7	9.571	0.080	11.7
12	3 17	51 34.1			
16	6 12	52 28.3	9.503	0.062	11.2
20	9 58	53 15.5			
24	14 55	53 54.2	9.421	0.046	10.7
28	21 28	54 26.9			
June 1	30 26	54 50.8	9.315	0.032	10.2
3	36 9	54 58.9			
5	42 57	55 3.9	9.248	0.027	9.8
7	15 51 7	55 5.0			
9	16 1 3	55 0.5	9.169	0.023	9.4
11	13 12	54 47.8			
13	28 11	54 23.0	9.071	0.019	8.8
15	47 16	53 37.8			
16	16 58 35	53 3.6	8.981	0.018	8.4
17	17 11 21	52 18.1			
18	17 25 46	51 17.7	8.911	0.017	8.0
19	17 42 0	49 56.7			
20	18 0 18	48 8.4	8.832	0.017	7.6
21	20 44	45 42.5			
22	18 43 17	42 26.6	8.745	0.017	7.2
23	19 7 49	38 5.1			
24	19 34 0	32 20.8	8.659	0.017	6.8
25	20 1 4	25 4.8			
26	28 28	16 21.5	8.598	0.018	6.5
27	20 55 22	+ 6 41.8			

1927 0h U.T.	α h m s	δ ° ′	Log. Δ	Log. r	Mag.
June 28	21 21 3	— 3 2.2	8.599	0.019	6.5
29	21 44 59	11 58.4			
30	22 6 51	19 36.2	8.662	0.020	6.8
July 1	26 31	25 49.3			
2	44 4	30 46.3	8.749	0.021	7.2
3	22 59 36	34 41.2			
4	23 13 20	37 47.5	8.837	0.023	7.7
5	25 24	40 16.3			
July 6	23 36 4	—42 16.7	8.916	0.025	8.1

b) COMET 1927 *d* (STEARNS). This comet is changing very little in appearance and brightness.

The elements are now better determined, as is shown by the two following orbits referred to the equinox of 1927.0.

Computer		H. Thiele (Berkeley)	B. Strömgren (Copenhagen)
Dates used		Mar. 13, 25, April 5	Mar. 10, 18, 31
Time of perihelion (U.T.)	T =	1927 Mar. 20.02161	Mar. 20.2338
Perihelion minus node	ω =	10° 36′ 11″.5	10° 38′.63
Longitude of node	Ω =	214 35 43.2	214 36.67
Inclination	i =	87 32 21.1	87 33.38
	Log. q =	0.565875	0.56631
Eccentricity	e =	0.991805	1

From the first elements H. Thiele has deduced the following ephemeris:

1927 0h U.T.	α h m s	δ ° ′	Log. Δ	M
April 29	14 42 17	+10 37.2	0.441	10.0
May 3	38 22	11 59.9	.444	
7	34 28	13 18.6	.447	
11	30 36	14 33.1	.451	
15	26 51	15 42.9	.456	
19	23 14	16 47.8	.461	
23	19 47	17 47.7	.465	
27	16 33	18 42.5	.475	
May 31	14 13 31	+19 32.3	0.482	10.2

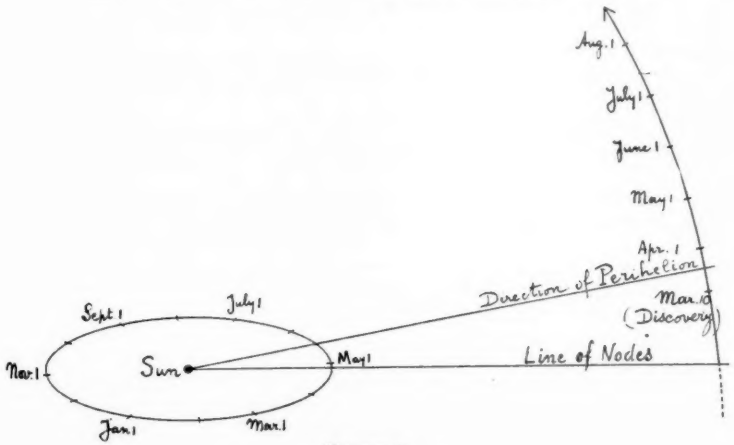


FIGURE 1.
ORBIT OF COMET 1927 *d* (STEARNS).

It will be noticed that according to this orbit there seems to be a small deviation from the parabola in the direction of the ellipse. But the corresponding period, amounting to 2 or 3 centuries, is of course still very uncertain. The object will continue to be well observable for a long time. Its computed brightness, which reached a maximum in the beginning of April falls off very slowly. The comet will be in opposition in the beginning of May, and then gradually move into the evening sky. There will be a curious approach of this comet to Arcturus on June 1, when the angular separation drops to 10′, one third of the apparent diameter of the moon. The diagram (Figure 1) shows the motion of the comet relatively to the orbit of the earth, represented as a foreshortened circle. The comet's large orbit is nearly at right angles to the ecliptic. It is clear that in late summer the angular distance to the sun may become too small for further observations but that next winter the conditions improve again.

c) Comet 1926 *f* (Comas Solá) was observed here again in the evening sky on April 22 as a well defined object of total brightness 13^{M}.5, with a sharp nucleus and a tail still visible over a length of 1′. Further observations are expected.

Williams Bay, Wisconsin, April 23, 1927.

METEOR NOTES.

By CHARLES P. OLIVIER.

We may assume that every report for 1926 from all our observers has arrived so a general résumé of the year's work can now be given. It was said in a previous note that last year was most unfavorable for meteor work. Nevertheless, something was accomplished by our members and some others who kindly comcunicated their results to us. Two tables give the main facts. Table I refers to meteors seen with the unaided eye; Table II to telescopic meteors only. We are indebted to members of the A.A.V.S.O. for practically all of these latter.

As so frequently happens, August furnished a very large percent of the total in Table I. We have almost nothing from the months of October, November, and December during which usually we have numerous observations of the Orionids, Leonids, and Geminids. One feature of interest in this report is that three observers in the Southern Hemisphere sent in good work, one from South Africa and two from New Zealand. The meteor streams south of the celestial equator are little known, and much remains to be done to bring our knowledge of them to the level of what we know of northern streams. Hence observations from observers, well south of the equator, are doubly valuable. The work of Dr. H. L. Alden, at Johannesburg, on the Perseids, has already been written up in the January *Meteor Notes*. Mr. R. M. Dole, of the U. S. Weather Bureau, and a veteran observer, has the credit for the largest contribution from any member.

Besides the persons mentioned in the tables many others have sent in reports of isolated bright or unusual meteors. A large number of new members have joined the A.M.S. during 1926, some of whose names appear in Table I. We regret that the majority of them reported nothing. How much of this was due to bad weather and how much to lack of industry is impossible to say, but the writer urges upon all members to make a real effort in 1927, as in Europe much valuable work is being turned out every year and unless our members stir themselves we shall fall rapidly behind in our relative output.

This occasion is taken to invite any readers interested in meteors to write and find out about the work of the American Meteor Society. The dues are only $1 per year, and instructions, with all the maps they can use are furnished free on request to all working members. Meteor work is specially suitable for an amateur who desires to do something useful and original, but who has no telescope. Besides being mentioned in the annual report, when the observations are definitely worked up, each member is given full credit for every contribution thereto. The writer has largely completed the memoir which contains the final results of the A.M.S. from 1919 to 1925 inclusive and hopes that it will appear in print during 1927. This memoir is to be distributed to all our members, as well as to the usual mailing list of the McCormick Observatory.

TABLE I.

Observer	Station	Nights	Meteors	Remarks
Alden, H. L.	Johannesburg, S. Africa	2	85	Perseid Maximum
Bradley, F. L.	University, Va.	2	59	
Campbell, L.	Norway, Me.	1	55	With 2 others. Count only.
Dole, R. M.	E. Lansing, Mich. Ogunquit, Me.	11	463	
Glover, Curtis	Melrose Heights, Mass	5	26	
Grote, A.	Chicago, Ill.	2	17	
Karp, Benjamin	Syracuse, N. Y.		49	17 on Aug. 11; rest on many nights.
Keller, Henry	Staunton, Va.	1	114	Count only, on Aug.12.
Koontz, D. L.	Chicago, Ill.	1	20	
Kovolenko, M.	University, Va.	1	27	
Levey, Miss L.	Syracuse, N. Y.		15	On several nights.
McIntosh, R.	Auckland, New Zealand	11	105	
Olivier, C. P.	University, Va.	3	150	
Thomson, I. L.	Danneviske, New Zealand	7	69	
Turnage, W. W.	University, Va.	1	150	Count only, on Aug.11.
Various			18	Mostly unusual or bright.
Hydrographic Office, U. S. N., and U.S.Weather Bureau			36	Mostly very bright, and observed from ships.
			1458	

TABLE II.

Observer	Station	Meteors
Bouton, Rev. T. C. H.,	St. Petersburg, Fla.	7
Chandler, F. H.,	Belgrade Lakes, Me.	5
Chandra, R. G.,	Bagchar, India	10
Ellsworth, Y.,	Lyons, France	6
Iedema, N.,	Great Neck, N. Y.	4
Olivier, C. P.,	University, Va.	1
Thomson, I. L.,	Danneviske, New Zealand	2
		35

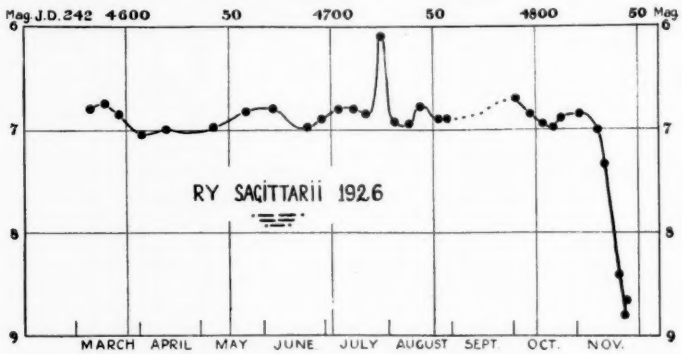
Leander McCormick Observatory, University, Va., 1927 April 21.

VARIABLE STARS.

RY Sagittarii.

After a prolonged period of faintness, beginning in 1921, this variable recovered its normal light, when unobservable, some time during the winter of 1924-25. After this the light remained steady, or with only slight fluctuation, for nearly two years, but a new and rapid decrease has recently set in. Observed here brightness was estimated on Nov. 10 to be 7.0; on Nov. 13, 7.3; Nov. 20, 8.4; Nov. 23, 8.8 and Nov. 24, 8.6.

As the star was nearing conjunction the last observations were made under rather difficult conditions, at low altitude in the south-western twilight, and are consequently subject to error; but there is no doubt that the decrease was of the rapid Algol-like type characteristic of stars of the R Coronae class.



The accompanying curve is drawn through my (1926) observations. These are not very numerous and on account of a change of latitude in September, none could be made in that month; still, they show the general character of the variation fairly well.

The normal brightness works out as 6.9. Apart from the drop in November, the most interesting point is the sudden increase in brightness, of short duration, indicated by a single observation on July 27. As to the minor sinuosities, I do not lay great stress on these as the observations are not particularly refined; however, I think most of them represent real fluctuations in the star's light. American observers may perhaps like to compare this curve with their own independent results.

Previously I had found RY Sagittarii brighter than normal in 1910 (Nov.), 1911 (April) and 1912 (July), whilst minima were observed in 1913 and 1922-23, the latter being a very faint one.

RY Sagittarii was discovered in 1896 at Gibraltar, Spain, by the late Col. Markwick who did such splendid work in organizing and directing the Variable Star Section of the British Astronomical Association. A binocular glass magnifying about five diameters was the instrument he used in comparing a zone of the southern heavens with the maps of the Uranometria Argentina, work which resulted in the discovery of this and other variables.

P. M. Ryves.

Zaragoza, Spain, January, 1927.

Minima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of Minima in 1927 June							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8					25 22			
RT Sculptor.	31.5	—26 13	9.6—10.5	0 12.3	8 2	15 18	23 11					
U Cephei	0 53.4	+81 20	7.0— 9.0	2 11.8		12 9	19 20	27 8				
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	6 21	13 0	19 3	24 5				
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	7 0	15 13	24 3					
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	5 12	12 9	19 6	26 3				
RZ Cassiop.	39.9	+69 13	6.9— 8.1	1 04.7	1 1	8 4	22 13	29 17				
TX Cassiop.	44.4	+62 22	9.4—10.1	2 22.2	3 21	12 16	21 10	30 5				
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	2 21	10 20	18 19	26 17				
RX Cassiop.	2 58.8	+67 11	8.6— 9.1	32 07.6	9 2							
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	2 13	11 4	19 18	28 9				
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	6 1	12 20	19 15	26 10				
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	1 9	9 7	17 5	25 2				
RW Tauri	3 57.8	+27 51	7.1— [11	2 18.5	2 22	11 5	19 13	27 20				
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	7 23	15 20	23 17					
RW Persei	13.3	+42 04	8.8—11.0	13 04.8	2 4	15 9	28 14					
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	5 4	11 11	24 1	30 8				
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1	8 8	20 18						
TT Aurigae	5 02.8	+39 27	7.8— 8.7	0 16.0	7 15	14 7	20 23	27 15				
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	1 21	9 23	18 4	26 8				
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	2 12	8 12	20 13	26 14				
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	5 4	13 20	22 12					
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9	2 22	13 8	23 18					
SV Gemin.	54.6	+24 28	9.8— [11	4 00.2	8 14	16 14	24 14					
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	5 3	10 20	22 7	28 1				
U Columbæ	6 11.2	—33 03	9.2—10.0	2 19.2	5 3	10 17	21 22	27 12				
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	8 18	16 23	25 4					
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	6 17	14 8	21 23	29 14				
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0	7 8		19 13					
RU Monoc.	6 49.4	— 7 28	9.8—10.5	0 21.5	4 2	11 6	18 10	25 14				
R Can. Maj.	7 14.9	—16 12	5.8— 6.4	1 03.3	2 14	9 10	23 1	29 20				
RY Gemin.	21.7	+15 52	8.9— [10	9 07.2	5 17	15 0	24 7					
Y Camelop.	27.6	+76 17	9.5—12	3 07.3	1 15	8 6	21 12	28 2				
TX Gemin.	30.3	+17 08	10.0—11.9	2 19.2	8 6	16 15	25 1					
RR Puppis	43.5	—41 08	9.4—10.7	6 10.3	1 15	8 1	20 22	27 8				
V Puppis	7 55.4	—48 58	4.1— 4.8	1 10.9	3 19	11 1	18 8	25 14				
X Carinæ	8 29.1	—58 53	7.9— 8.7	0 13.0	1 7	9 10	17 13	25 16				
S Cancri	8 38.2	+19 24	8.2—10	9 11.6	3 1	12 13	22 1					
RX Hydræ	9 00.8	— 7 52	9.1—10.5	2 06.8	3 23	10 19	17 16	24 12				
S Velorum	29.4	—44 46	7.8— 9.3	5 22.4	5 13	11 11	23 8	29 6				
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	3 9	10 3	23 14	30 8				
RR Velorum	10 17.8	—41 36	10.0—10.9	1 20.5	6 12	13 22	21 8	28 18				
SS Carinæ	10 54.2	—61 23	12.2—12.8	3 07.2	1 18	8 18	21 13	28 3				
ST Urs. Maj.	11 22.4	+45 44	6.7— 7.2	8 19.2	8 17	17 12	26 8					
RW Urs. Maj.	35.4	+52 34	10.3—11.4	7 07.9	1 20	9 4	16 12	23 20				
Z Draconis	11 39.8	+72 49	9.9—13.6	1 08.6	1 17	8 12	22 1	28 20				
RZ Centauri	12 55.6	—64 05	8.5— 8.9	1 21.0	2 7	9 19	17 7	24 19				
RS Can. Ven.	13 06.3	+36 28	7.5—12.5	4 19.1	6 11	16 1	25 16					
SS Centauri	07.2	—63 37	8.8—10.4	2 11.5	2 5	9 16	17 2	24 13				

Minima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of Minima in 1927 June							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SX Hydræ	13 39.0	−26 23	8.6—12.7	2 21.5	1 7	9 23	18 16	27 8				
δ Libræ	14 55.6	− 8 07	4.8— 6.2	2 07.9	6 5	13 5	20 4	27 4				
U Coronæ	15 14.1	+32 01	7.6— 8.7	3 10.9	1 20	8 17	22 12	29 10				
TW Draconis	15 32.4	+64 14	7.3— 8.9	2 19.4	7 5	15 15	24 1					
SS Libræ	15 43.4	−15 14	9.3—11.5	0 18.4	1 1	8 6	22 15	29 20				
SW Ophiuchi	16 11.1	− 6 44	9.2—10.0	2 10.7	7 11	14 20	22 4	29 12				
SX Ophiuchi	12.6	− 6 25	10.5—11.2	2 01.5	7 13	15 19	24 1					
R Aræ	31.1	−56 48	6.8— 7.9	4 10.2	3 9	12 5	21 2	29 22				
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1		12 7						
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	7 6	14 1	20 21	27 16				
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	1 16.2	8 5	16 14	24 23					
u Herculis	13.6	+33 12	4.6— 5.4	2 01.2	2 6	8 10	20 17	26 21				
TX Herculis	15.4	+42 00	8.3— 9.0	2 01.4	2 0	8 4	20 12	26 17				
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	5 16	13 1	20 10	27 19				
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	1 8	9 13	17 17	25 21				
TX Scorpii	48.6	−34 13	7.5— 8.2	0 22.6	7 6	14 19	22 8	29 21				
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2	2 15	10 9	18 3	25 21				
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	5 7	13 6	21 6	29 6				
WX Sagittarii	53.6	−17 24	9.2—10.8	2 03.1	8 18	17 7	25 19					
WY Sagittarii	17 54.9	−23 01	9.5—10.6	4 16.0	3 12	12 20	17 12	26 21				
SX Draconis	18 03.0	+58 23	9.3—10.5	5 04.1	5 0	15 8	20 12	30 20				
RS Sagittarii	11.0	−34 08	5.9— 6.3	2 10.0	4 16	11 22	19 4	26 10				
V Serpentis	11.1	−15 34	9.5—11.1	3 10.9	7 15	14 13	21 11	28 8				
RZ Scuti	21.1	− 9 15	7.4— 8.3	15 03.2		11 0	25 4					
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	8 0	14 4	21 8	28 12				
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	5 12	12 14	19 17	26 20				
SX Sagittarii	39.7	−30 36	8.7— 9.8	2 01.8	3 9	11 16	20 0	28 7				
RR Draconis	40.8	+62 34	9.3—13	2 19.9	4 9	12 20	21 8	29 20				
RS Scuti	43.7	−10 21	9.3—10.3	0 15.9	6 5	12 20	19 12	26 3				
β Lyræ	46.4	+33 15	3.4— 4.1	12 21.8	7 15		20 12					
U Scuti	18 48.9	−12 44	9.1— 9.6	0 22.9	3 17	11 9	20 0	26 15				
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.4	1 23	9 13	17 3	24 16				
RV Lyræ	12.5	+32 15	11. —12.8	3 14.4	5 19	13 0	20 5	27 10				
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	8 0	16 23	25 22					
U Sagittæ	14.4	+19 26	6.5— 9.0	3 09.1	6 3	12 21	19 16	26 10				
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	4 19	12 4	19 13	26 21				
TT Lyræ	24.3	+41 30	9.4—11.6	5 05.8	2 23	13 11	18 16	29 4				
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	2 3	8 16	21 17	28 5				
SY Cygni	19 42.7	+32 28	10. —12	6 00.2	2 18	8 18	20 19	26 19				
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	1 21	8 12	21 19	28 10				
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	3 6	12 9	21 13	30 16				
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	8 19	17 5	25 15					
RW Capric.	12.2	−17 59	8.8—10.6	3 09.4	5 11	12 6	19 1	25 19				
UW Cygni	19.6	+42 55	10.5—13	3 10.8	7 6	14 3	21 1	27 22				
V Vulpec.	32.3	+26 15	8.2— 9.8	37 19.0								
W Delphini	33.1	+17 56	9.4—12.1	4 19.4	5 3	14 18	19 13	29 4				
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	9 19	19 0	28 5					
Y Cygni	48.1	+34 17	7.1— 7.9	2 23.9	8 18	17 18	26 17					
WZ Cygni	49.3	+38 27	9.9—10.8	0 14.0	6 8	13 22	21 12	29 3				
RR Vulpec.	20 50.5	+27 32	9.6—11.0	5 01.2	3 12	13 15	23 17					
RY Aquarii	21 14.8	−11 14	8.8—10.4	1 23.2	4 8	12 5	20 2	27 23				
UZ Cygni	55.2	+43 52	8.9—11.6	31 07.3		9 21						
RT Lacertæ	21 57.4	+43 24	9.1—10.5	5 01.7	3 6	13 10	18 11	28 15				
RW Lacertæ	22 40.6	+49 08	10.2—11.2	5 04.4	3 7	13 16	18 20	29 5				
VW Pegasi	51.7	+32 42	10.0—10.6	5 06.4	1 3	11 15	16 22	27 11				
Y Piscium	23 29.3	+ 7 22	9.0—12.0	3 18.4	8 6	15 19	23 8	30 21				
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	8 16	16 21	25 3					

Maxima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5h; Central Standard time 6h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of maxima in 1927							
					June							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SX Cassiop.	0 05.5	+54 20	8.6— 9.2	36 13.7			11 16					
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 01.7	4 8		12 12		20 15		28 18	
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	2 3		9 21		17 15		25 9	
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2	8 5				23 1			
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	6 7		14 6		22 5		30 4	
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	6 20		14 15		22 10		30 5	
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0			10 0		26 9			
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	4 3		12 17		21 7		29 21	
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1			10 14		21 17			
RX Aurigæ	4 54.5	+39 49	7.2— 8.1	11 15.0	4 1		15 4		27 7			
SX Aurigæ	5 04.6	+42 02	8.0— 8.7	1 12.8	6 8		14 1		21 16		29 7	
SY Aurigæ	05.5	+42 41	8.4— 9.5	10 03.3	9 12		19 16		29 19			
Y Aurigæ	21.5	+42 21	8.6— 9.6	3 20.6	6 17		14 10		22 3		29 21	
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	5 14		11 3		22 5		27 17	
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	7 15		15 4		22 18		30 7	
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3							25 12	
RT Aurigæ	23.0	+30 33	5.1— 6.0	3 17.5	8 4		15 15		23 2		30 13	
W Gemin.	29.2	+15 24	6.7— 7.5	7 22.0	5 23		13 22		21 19		29 17	
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	5 1		15 5		25 8			
RU Camelop.	7 10.9	+69 51	8.5— 9.8	22 06.5	4 10				26 17			
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	7 16		15 15		23 13			
V Carinæ	8 26.7	—59 47	7.4— 8.1	6 16.7	4 11		11 3		17 20		24 13	
T Velorum	8 34.4	—47 01	7.6— 8.5	4 15.3	2 17		11 23		21 6		30 12	
V Velorum	9 19.2	—55 32	7.5— 8.2	4 08.9	8 6		17 0		25 17			
Z Leonis	9 46.4	+27 22	7.9— 9.6	56 08.7			17 3					
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	5 13		12 8		19 3		25 22	
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	6 12		13 2		19 17		26 7	
S Muscæ	12 07.4	—69 36	6.4— 7.3	9 15.8	2 8		12 0		21 16			
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	1 12		9 11		17 10		25 10	
T Crucis	15.9	—61 44	6.8— 7.6	6 17.6	7 15		14 8		21 2		27 19	
R Crucis	18.1	—61 04	6.8— 7.9	5 19.8	3 0		8 19		20 11		26 7	
S Crucis	12 48.4	—57 53	6.5— 7.6	4 16.6	3 15		13 1		17 17		27 2	
W Virginis	13 20.9	— 2 52	8.7—10.4	17 06.5	8 7				25 14			
SS Hydræ	25.0	—23 08	7.4— 8.1	8 04.8	6 3		14 8		22 12		30 17	
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	5 6		12 7		19 7		26 8	
ST Virginis	14 22.5	— 0 27	10.3—11.4	0 09.9	2 2		9 12		16 21		24 7	
V Centauri	25.4	—56 27	6.4— 7.8	5 11.9	3 23		9 11		20 11		25 23	
RS Bootis	29.3	+32 11	8.9—10.0	0 09.1	4 10		11 23		19 12		27 2	
R Trian.Austr.	15 10.8	—66 08	6.7— 7.4	3 09.3	2 2		8 21		22 10		29 5	
S Trian.Austr.	15 52.2	—63 29	6.4— 7.4	6 07.8	1 9		7 17		20 8		26 16	
S Normæ	16 10.6	—57 39	6.6— 7.6	9 18.1	4 1		13 18		23 12			
RW Draconis	33.7	+58 03	9.6—10.3	0 10.6	3 4		12 1		20 21		29 18	
RV Scorpii	16 51.8	—33 27	6.7— 7.4	6 01.5	3 6		9 7		21 10		27 12	
X Sagittarii	17 41.3	—27 48	4.4— 5.0	7 00.3	1 8		8 8		22 9		29 9	
Y Ophiuchi	47.3	— 6 07	6.1— 6.5	17 02.9			13 0				30 3	
W Sagittarii	17 58.6	—29 35	4.3— 5.1	7 14.3	1 19		9 19		16 23		24 13	
Y Sagittarii	18 15.5	—18 54	5.4— 6.2	5 18.6	4 8		10 3		21 16		27 10	
U Sagittarii	26.0	—19 12	6.5— 7.3	6 17.9	7 8		14 2		20 19		27 13	
Y Scuti	32.6	— 8 27	8.7— 9.2	10 08.3	8 7		18 15		28 23			
RZ Lyræ	39.9	+32 42	9.9—11.2	0 12.3	6 12		14 4		21 20		29 12	
RT Scuti	18 44.1	—10 30	9.1— 9.7	0 11.9	5 19		13 6		20 16		28 2	
κ Pavonis	18 46.6	—67 22	3.8— 5.2	9 02.2	7 20		16 22		26 0			
U Aquilæ	19 24.0	— 7 15	6.2— 6.9	7 00.6	1 8		8 8		22 10		29 10	
XZ Cygni	19 30.4	+56 10	8.6— 9.3	0 11.2	6 3		13 3		20 3		27 3	

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of maxima in 1927 June							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
U Vulpec.	32.2	+20 07	6.5— 7.6	7 23.5	5 15	13 14	21 14	29 13				
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	8 6	15 23	23 16					
η Aquilæ	47.4	+ 0 45	3.7— 4.5	7 04.2	7 17	14 21	22 1	29 6				
S Sagittæ	51.5	+16 22	5.6— 6.4	8 09.2	2 12	10 22	19 7	27 16				
X Vulpec.	19 53.3	+26 17	9.5—10.5	6 07.7	2 17	9 1	21 16	28 0				
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3	4 9		20 18					
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	9 6	18 3	27 0					
UY Cygni	52.3	+30 03	9.6—10.4	0 13.5	5 16	12 23	20 5	27 12				
RV Capric.	55.9	—15 37	9.2—10.1	0 10.7	2 1	9 5	23 13	30 16				
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4		10 16	25 9					
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	8 5	16 2	23 22					
SW Aquarii	10.2	— 0 20	9.9—10.8	0 11.0	3 8	10 6	24 1	30 22				
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	7 4	16 22	26 15					
Y Lacertæ	22 05.2	+50 33	9.1— 9.6	4 07.8	6 15	15 7	23 23					
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	5 15	11 0	21 17	27 2				
Z Lacertæ	36.9	+56 18	8.2— 9.0	10 21.1		11 5	22 2					
RR Lacertæ	37.5	+55 55	8.5— 9.2	6 10.1	6 21	13 7	19 17	26 3				
V Lacertæ	44.5	+55 48	8.5— 9.5	4 23.6	2 7	12 7	22 6					
X Lacertæ	22 45.0	+55 54	8.2— 8.6	5 10.7	5 14	11 1	21 22	27 9				
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	2 0	12 22	18 8	29 !				
RS Cassiop.	32.6	+61 52	9.0—11.0	6 07.1	2 5	8 12	21 2	27 9				
RY Cassiop.	47.2	+58 11	9.3—11.8	12 03.4	4 22	17 1	29 5					
V Cephei	23 51.7	+82 38	6.0— 7.0	0 23.9	4 21	11 20	18 20	25 19				

Monthly Report of the American Association of Variable Star Observers, for the Month ending March 31, 1927.

The cloudy weather of the past month has had a deterring effect on our observing, as indicated by the slight decrease in the number of observations contributed to this report. Mr. Chandra sends for the first time some observations made by him with the Elmer Glass set up on a temporary mounting. The Telescope Committee, through the kindness of Director Shapley, will soon be able to send Mr. Chandra a permanent mounting for the telescope and then we can expect still greater results.

Messrs. Lutz and Braid-White paid their respects to the Headquarters of the Association during March. Mr. Olcott is on his way north again after a season spent in Ussepa Isle, Fla., and Mr. Rhorer has had a most profitable season with his co-workers at the Southern Cross Observatory at Miami, Fla. Professor E. B. Frost greatly assisted the movement at Miami by giving two most delightful and much appreciated lectures while visiting in southern climes.

Recent observations indicate that RY Sagittarii—one of the R Cor. Bor. type stars—has resumed normal maximum brightness once more. It apparently did not fade away to its customary thirteenth magnitude or fainter during its recent minimum. R Aquarii has been subject to peculiar fluctuations during recent months and fortunately it has been closely observed by our band of observers, both north and south. Any observer finding U Geminorum brighter than magnitude 13 during the next few months, is urgently requested to notify the Recording Secretary at once, preferably by wire. It should be at maximum again sometime during the month of May.

President Godfrey reports that, at the invitation of Professor Schlesinger, the Spring Meeting of the Association will be held at the Yale Observatory, New Haven, Conn., on May 21, 1927. A large attendance is anticipated.

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1927.

Jan. 0 = J.D. 2424881; Feb. 0 = J.D. 2424912; Mar. 0 = J.D. 2424940.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V SCL	T PHE	U AND	R ARI	R FOR	R HOR
000339	*002546*	010940	021024	*022426*	*025050*
888 13.5 Bl	904[13.6 Bl	929 9.8 B	913 10.3 Ch	888 8.6 Bl	888 5.7 Bl
908 12.8 Bl	910[12.2 Sm	933 9.6 Lg	916 10.9 L	899 8.5 Bl	889 6.0 En
S SCL	W SCL	S CAS	929 11.3 B	907 8.6 Bl	890 6.1 Ht
001032	*002833*	011272	930 11.2 Lv	U CET	899 5.8 Bl
888 7.7 Sm	904 13.0 Bl	901 8.5 Ch	931 11.6 L	*022813*	902 6.6 Ht
888 8.1 Bl	U CAS	930 9.2 Ch	932 10.5 Ch	904 11.4 Ch	903 6.6 En
889 7.8 En	004047	933 9.3 Pt	933 11.9 Pt	933 11.6 Pt	907 6.8 Bl
890 8.2 Ht	929 10.6 Lv	935 8.8 B	944 12.1 B	934 10.3 B	908 6.5 Ht
899 8.4 Bl	933 10.5 Pt	938 9.6 Eb	W AND	RR CEP	911 6.9 Sm
902 8.7 Ht	938 9.7 Kz	938 9.4 Kz	021143a	022980	913 6.8 En
907 8.9 Bl	938 10.0 Eb	941 9.9 Ya	902 8.8 Ch	931 13.6 L	T HOR
908 9.1 Ht	941 9.8 Ya	944 9.7 Bx	913 8.2 Ch	R TRI	*025751*
910 8.3 Sm	948 8.7 B	U PSC	929 7.5 B	023133	904 13.0 Bl
912 8.9 En	V AND	011712	933 7.7 Pt	902 8.4 Ch	911[12.7 Sm
X AND	004435	933 13.4 Pt	934 8.2 Cl	910 7.9 Ch	U ARI
001046	883 13.3 Bg	RZ PER	938 8.1 Kz	916 7.2 Ch	030514
883 13.1 Bg	890 13.4 Bg	012350	938 8.2 Eb	929 7.1 B	884 14.8 Bg
890 13.3 Bg	901 12.7 Bg	929 9.2 B	955 8.2 Ie	930 6.6 Lv	890[14.2 Bg
893 13.4 Bf	906 12.6 Bg	948 9.6 B	T PER	933 6.8 Pt	906 14.7 Bg
901 13.4 Bg	908 12.6 Bg	R PSC	021258	934 6.9 Jo	X CET
906 13.6 Bg	911 12.5 Bg	012502	905 8.9 Ch	941 7.0 Jo	*031401*
908 13.7 Bg	929 11.3 Lv	883 10.1 Bg	933 8.8 Pt	941 6.2 Ya	916 9.7 L
911 14.2 Bg	933 11.2 B	890 9.0 Bg	Z CEP	938 6.7 Kz	931 11.1 L
T AND	944 10.2 B	904 7.8 Ch	021281	938 6.6 Eb	933 10.5 Pt
001726	X SCL	906 8.0 Bg	933 13.4 Pt	943 6.9 Lv	Y PER
901 10.7 Ch	*004435*	911 7.8 Bg	o CET	955 7.3 Ie	032043
914 10.5 Ch	904 12.4 Bl	933 7.8 Pt	*021403*	955 7.0 Jo	732 9.2 Nk
933 9.5 Pt	RR AND	RU AND	889 6.6 En	W PER	735 9.1 Nk
938 9.0 Kz	004533	013238	901 5.7 Ch	024356	736 9.0 Nk
938 9.0 Eb	883[14.8 Bg	932 11.3 Ch	905 6.0 Rw	730 9.3 Nk	738 9.2 Nk
T CAS	890[14.6 Bg	933 11.1 Pt	907 6.2 Ch	733 9.0 Nk	739 9.2 Nk
001755	901[14.6 Bg	933 11.0 B	911 5.4 Sm	738 9.3 Nk	791 9.4 Nk
901 9.8 Ch	906 15.5 Bg	941 11.0 Ya	912 6.3 Ch	739 9.0 Nk	822 9.2 Nk
913 9.7 Ch	908 15.4 Bg	944 11.0 Bx	912 7.0 En	740 9.3 Nk	825 9.3 Nk
916 9.0 L	911 15.6 Bg	944 10.8 B	915 6.4 Ch	741 9.3 Nk	909 9.4 Nk
929 9.2 B	— CAS	Y AND	916 7.0 Lg	742 9.3 Nk	917 9.9 Ch
931 8.8 L	004746b	013338	918 6.6 Ch	790 9.1 Nk	929 9.7 B
933 8.8 Pt	933 10.9 Pt	933 13.1 Pt	931 6.6 L	822 9.1 Nk	933 10.0 Pt
934 9.0 Jo	W CAS	933 13.0 B	933 7.2 Ch	825 9.1 Nk	941 9.6 Ya
936 9.4 Gg	004958	941[11.4 Ya	933 7.0 Pt	828 9.1 Nk	945 9.7 B
938 9.2 Kz	933 11.5 En	944 12.4 B	934 7.3 Jo	829 9.1 Nk	R PER
938 9.3 Eb	933 12.0 Pt	X CAS	934 7.0 Rw	831 9.1 Nk	032335
941 9.2 Ya	944 11.7 B	014958	938 7.5 Eb	842 9.1 Nk	935 10.3 B
941 8.8 Jo	U TUC	933 10.4 B	938 7.2 Kz	847 9.0 Nk	941 10.0 Ie
944 9.2 Bx	*005475*	933 10.0 Pt	941 7.6 Jo	848 9.1 Nk	941 10.0 Jo
955 9.0 Jo	888 10.1 Bl	936 10.7 Bn	S PER	859 9.1 Nk	941 9.7 Ya
R AND	889 10.3 Sm	944 10.3 B	021558	884 9.2 Nk	944 9.8 B
001838	889 10.8 En	947 10.7 Bn	905 8.7 Ch	885 9.2 Nk	R TAU
933 14.0 Pt	899 10.6 Bl	U PER	933 8.6 Pt	891 9.1 Nk	042209
S TUC	903 11.2 En	015254	935 8.8 B	917 9.4 Ch	883 9.8 Bg
001862	907 11.2 Bl	929 9.8 B	941 8.7 Ya	933 9.0 Pt	892 9.7 Bf
889[12.4 Sm	910 11.6 Sm	933 10.2 Pt	948 8.9 B	935 9.0 B	905 9.7 Ch
904 13.4 Bl	910 11.2 En	948 9.3 B	R CET	941 9.1 Ya	907 10.1 Bg
910[12.4 Sm	Z CET	S ARI	*022000*	944 9.0 Bx	911 10.1 Bg
S CET	*010102*	015912	904 9.8 Ch	948 9.1 B	933 10.8 Pt
001909	933 13.6 Pt	935[14.0 B	RR PER	955 9.1 Cl	933 9.5 Pt
916[13.3 L	U SCL	R ARI	022150	R HOR	934 10.6 B
	010630	021024	933 13.8 B	*025050*	941 10.7 Ie
	904[13.2 Bl	902 9.4 Ch	944 13.7 B	885 6.1 Sm	941 11.0 Ya

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1927—Continued.

J.D.Est.Obs.

R TAU
042209
944 10.8 B

W TAU
042215
911 10.2 Mh
927 9.2 Ph
929 9.8 B
934 9.6 Jo
941 9.9 Jo
943 10.0 Ya
945 10.0 B
955 10.6 Jo

S TAU
042309
883 15.8 Bg
892[14.8 Bf
907[15.3 Bg
911[15.4 Bg
934[13.0 B
943[11.0 Ya
944[13.0 B

T CAM
043065
922 14.0 L
933 13.5 Pt

RX TAU
043208
929 10.5 B
930 10.8 Lv
933 10.2 Pt
943 11.1 Lv
944 11.1 B

R RET
043263
888 12.0 Bl
889 12.2 En
890 12.0 Ht
899 11.2 Bl
902 11.4 Ht
903 11.2 En
907 10.4 Bl
908 11.0 Ht
911 11.0 Sm
912 10.4 En

X CAM
043274
912 11.0 Ch
933 9.2 B
933 9.1 Pt
943 8.6 Ya
944 8.3 B

R DOR
043562
888 5.4 Bl
889 5.8 En
890 5.6 Ht
899 5.5 Bl
902 5.5 Ht
903 5.8 En
907 5.4 Bl
908 5.5 Ht

R DOR
043562
911 5.5 Sm
912 5.8 En

R CAE
043738
890[12.0 Ht
904[12.5 Bl
908[12.0 Ht

R PIC
044349
888 9.3 Bl
899 8.6 Bl
907 7.8 Bl

V TAU
044617
910 9.9 Ch
933 9.5 Pt
934 9.5 B
941 9.7 Ie
943 9.6 Ya
945 9.7 B

R ORI
045307
933 11.8 B
938[11.2 Kz
941 12.0 Ie
944 11.8 B

R LEP
045514
901 9.5 Ch
909 9.3 Ch
911 8.5 Mh
922 8.0 L
929 8.5 B
929 9.4 Ch
931 8.2 L
933 8.5 Pt
934 8.0 Jo
936 8.5 Wa
941 8.1 Jo
943 9.2 Ya
955 7.3 Jo

V ORI
050003
933 10.0 Pt
934 9.2 B
941 9.1 Ie
944 9.3 Ya
945 9.0 B

T LEP
050022
888 9.0 Bl
899 8.9 Bl
907 8.9 Bl
933 9.4 Pt
934 9.0 B
948 9.7 B

S PIC
050848
889[12.2 En
903[12.9 En

S PIC
050848
904[13.4 Bl
911[12.2 Sm
912[12.2 En

R AUR
050953
913 11.1 Mh
929 11.8 Lv
933 11.8 Pt
938[11.1 Eb
943 12.1 B
943 12.7 Lv

T PIC
051247
888 11.4 Bl
889 11.4 En
890 11.6 Ht
899 11.8 Bl
903 12.2 En
904 12.8 Ht
907 12.9 Bl
908 12.8 Ht
912 12.5 En

T COL
051533
888 12.2 Bl
889 11.7 Sm
890 11.9 Ht
891 11.4 En
899 11.9 Bl
903 11.9 En
904 11.9 Ht
907 12.1 Bl
908 11.9 Ht
911 11.9 Sm
912 12.1 En

S AUR
052034
904 10.0 Ch
922 9.2 L
933 9.3 Pt
943 9.8 B
944 9.3 Ya
946 9.8 Sg

W AUR
052036
932 13.4 L
933 13.7 B
933 14.1 Pt
943 13.6 Ie

S ORI
052404
893 8.9 Ph
933 8.8 Pt
934 8.9 B
944 9.5 Ya
948 9.0 B
949 9.6 Al

T ORI
053005a
739 10.5 Nk

T ORI
053005a
825 11.1 Nk
886 11.0 Nk
891 10.9 Nk
892 9.9 Ph
893 9.8 Ph
909 10.7 Nk
916 10.4 L
922 10.8 L
923 10.7 L
925 10.8 L
931 10.3 L
932 10.3 L
933 10.6 B
933 10.4 Pt
935 10.2 Pt
936 10.0 Pt
940 10.8 Ae
941 10.2 Ya
942 10.1 Pt
943 10.1 Pt
943 10.4 B
943 10.3 Ya
944 10.8 Ae
944 10.1 Pt
945 10.8 B
948 10.0 Pt
949 10.2 Pt
950 10.2 Pt
951 11.0 Ie
953 10.0 Pt
953 10.2 B
955 10.5 Pt
956 10.5 Pt
958 10.3 Pt

S CAM
053068
933 8.4 Pt
943 8.6 Ya

RR TAU
053326
883 12.4 Bg
884 12.3 Bg
889 12.6 Bg
892 12.6 Bf
906 12.5 Bg
907 12.3 Bg
908 12.1 Bg
909 12.2 Bf
911 13.1 Bg
943 12.3 B

RU AUR
053337
933[12.0 Pt

U AUR
053531
904 9.8 Ch
933 11.2 Pt
933 10.8 B
955 11.9 Ie

SU TAU
054319
903 9.7 Ch
907 9.7 Ch
912 9.7 Ch
923 10.5 L
929 9.9 B
930 10.1 Lv
932 10.7 L
933 10.1 Pt
933 10.0 B
934 10.0 Ae
935 10.3 Pt
936 10.3 Pt
940 10.1 Ie
940 10.1 Ae
942 10.2 Pt
943 10.2 Pt
943 10.0 Lv
943 9.9 B
944 10.2 Pt
945 10.0 B
948 10.2 Pt
949 10.2 Pt
953 10.2 Pt
953 9.9 B
954 10.3 Lv
955 10.3 Pt
955 10.0 Ae
956 10.2 Pt
958 10.2 Pt

S COL
054331
888 10.0 Bl
889 9.8 Sm
890 9.9 Ht
891 10.0 En
899 9.4 Bl
903 9.7 En
904 9.6 Ht
907 9.5 Bl
908 9.6 Ht
911 9.9 Sm
912 9.7 En

Z TAU
054615a
883 14.2 Bg
892 14.1 Bf
906 14.1 Bg
909 13.9 Bf

RU TAU
054615c
883 10.4 Bg
892 10.5 Bf
893 10.2 Ph
906 10.3 Bg
909 10.6 Bf
919 10.6 Ph
938 10.6 Ph
940 11.5 Ie

R COL
054629
888 12.2 Bl
890 12.5 Ht
891 12.4 En
899 11.3 Bl
903 11.4 En
904 11.7 Ht
907 11.2 Bl
908 11.7 Ht
911 10.4 Sm
912 10.7 En

U ORI
054920a
739 8.3 Nk
740 8.2 Nk
741 8.3 Nk
742 8.2 Nk
821 7.9 Nk
825 8.1 Nk
828 8.4 Nk
849 8.7 Nk
854 8.9 Nk
903 10.4 Ch
906 10.9 Mh
907 10.0 Nk
912 10.6 Ch
933 10.8 Pt
938 10.8 Kz
938 10.4 Eb
942 10.8 Al
943 10.9 B
943 11.6 Lv

UW ORI
054920b
906 11.4 Mh
938 10.6 Kz
938 10.6 Eb
943 10.9 Lv

Z AUR
055353
904 10.2 Ch
912 9.7 Ph
914 9.8 Gg
933 10.0 B
933 9.9 Pt
935 10.0 Pt
936 10.0 Pt
940 10.6 Ae
942 10.0 Pt
943 10.0 Pt
944 10.0 Pt
944 10.0 Ya
944 10.5 Ae
945 10.3 B
948 10.0 Pt
949 10.2 Pt
950 10.3 Pt
953 10.7 Pt
953 10.5 B
955 10.8 Pt
956 10.8 Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1927—Continued.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
Z AUR	Y MON	V GEM	U PUP	RW CAR	R LEO
055353	065111	071713	*075612*	*001868*	094211
958 10.7 Pt	944 8.7 Wa	933 13.1 Pt	904 10.8 Ch	899 9.3 Bl	934 6.5 Jo
R OCT	944 8.7 Ya	S CMI	944 12.0 Ae	907 9 5 Bl	936 6.6 Wa
055686	X MON	072708	944 11.9 B	912 9.4 En	938 6.5 Kz
885 11.5 Sm	*065208*	938 9.0 Al	R CNC	Y VEL	938 6.6 Eb
888 11.8 Bl	904 9.4 Ch	906 7.5 Mh	081112	*092551*	941 6.8 Jo
899 11.6 Bl	922 8.5 L	907 6.8 Ch	902 10.2 Ch	888 10.2 Bl	941 6.5 Wa
907 11.7 Bl	933 9.1 Cb	911 7.0 Ch	906 10.4 Mh	889 10.1 Sm	942 7.7 Cb
910 11.5 Sm	936 9.2 Cb	915 7.4 Ch	915 10.0 Ch	891 10.4 En	944 6.6 Wa
X AUR	938 9.5 Kz	915 7.1 Wa	922 10.1 L	899 10.5 Bl	946 6.4 Al
060450	938 9.7 Eb	922 7.6 L	931 9.5 Ch	907 10.9 Bl	952 6.6 Al
900 8.6 Ch	942 9.2 Cb	929 7.9 Ch	933 9.7 Pt	910 11.1 Sm	Y HYA
903 8.7 Ch	944 9.5 Cb	933 8.2 Pt	951 8.4 Ie	912 11.3 En	*094622*
906 8.7 Ch	V CMI	934 8.1 Jo	V CNC	R CAR	935 6.4 Pt
909 8.7 Ch	070109	941 8.5 Jo	081617	*092962*	Z VEL
912 8.7 Ch	901[11.4 Ch	941 8.4 Wa	906 11.5 Ch	888 9.2 Sm	*094953*
915 8.7 Ch	R GEM	942 8.5 Al	931 9.6 Ch	888 9.1 Bl	889 12.6 Bl
918 8.7 Ch	070122a	951 8.8 Ie	935 9.3 Pt	890 9.7 Ht	889 12.5 Sm
930 8.9 Ch	901 7.7 Ch	952 8.4 Al	RT HYA	899 9.2 Bl	891 12.4 En
933 9.0 Pt	906 8.0 Mh	955 8.6 Jo	*082405*	902 9.8 Ht	899 12.4 Bl
934 9.1 Ch	909 8.0 Ch	Z PUP	935 7.6 Pt	907 9.1 Bl	904 12.8 Ht
943 9.3 B	929 8.0 Ch	*073820b*	949 8.0 Ae	908 9.9 Ht	907 12.5 Bl
955 10.9 Ie	933 8.6 Pt	944 12.8 Ae	R CHA	910 9.5 En	908 12.5 Ht
V MON	933 9.1 Cb	S VOL	*082476*	910 9.0 Sm	910 12.6 Sm
061702	934 8.7 Jo	*073173*	888[13.0 Bl	X HYA	912 12.6 En
904 8.2 Ch	938 9.3 Kz	888 12.4 Bl	889[12.4 Sm	*093014*	V LEO
933 8.5 Pt	938 9.6 Eb	899 11.8 Bl	899[12.6 Bl	887 9.4 Bf	095421
R MON	941 8.8 Al	907 11.8 Bl	903[12.4 En	895 9.6 Bf	898 9.8 Ph
063308	941 8.8 Jo	U CMI	907[13.2 Bl	905 10.0 Bf	906 10.4 Ch
933 11.0 Pt	942 9.1 Cb	073508	910[12 4 En	906 10.0 Ch	916 9.0 Ch
NOV PIC	949 9.3 Al	922 10.7 L	S HYA	909 10.0 Bf	935 9.4 B
063462	955 9.5 Ie	932 10.7 L	084803	912 10.3 Bf	935 9.1 Pt
885 6.3 Sm	955 9.1 Jo	933 9.9 Pt	916 10.2 Ch	917 10.9 Ch	RV CAR
888 6.3 Sm	Z GEM	S GEM	931 9.8 Ch	934 11.5 B	*095563*
889 6.3 Sm	070122b	073723	935 9 4 Pt	935 11.2 Pt	904[13.1 Bl
890 6.2 Ht	933 12.4 Pt	903 12.5 Ch	T HYA	945 11.8 B	S CAR
902 6.2 Ht	938[11.6 Eb	917 12.6 Ch	*085008*	Y DRA	*100661*
904 6.3 Ht	TW GEM	932 13.7 Ch	902 9.5 Ch	093178	888 6.9 Sm
908 6.5 Ht	070122c	933 13.1 Pt	916 8.8 Ch	916 9.7 Ch	888 6.9 Bl
910 6.3 Sm	933 7.8 Pt	W PUP	922 8.3 L	934 8.8 Cl	889 7.0 En
911 6.3 Sm	R CMI	*074241*	931 8.2 Ch	R LMI	890 6.9 Ht
911 6.5 Ht	070310	888 11.4 Sm	935 8.0 Pt	093934	899 6.6 Bl
912 6.3 En	901 9.3 Ch	888 10.6 Bl	T CNC	904 11.6 Ch	902 6.5 Ht
S LYN	922 9.2 L	890 11.2 Ht	085120	907 11.6 Ch	903 6.3 En
063558	944 9.7 Wa	891 11.4 En	906 9.3 Ch	913 11.3 Ch	907 5.8 Bl
933 14.6 Pt	R VOL	899 12.1 Bl	935 8.5 Pt	924 10.9 L	908 6.2 Ht
X GEM	*070772*	902 12.3 Ht	T PYX	930 11.1 Ch	910 6.0 Sm
064030	885 12.6 Sm	907 12.6 Bl	*090031*	933 10.8 Ch	910 5.6 En
938[12.9 Kz	889 12.6 En	908 12.6 Ht	904 Ju Bi	935 10.4 B	Z CAR
939 12.8 Bn	890 12.2 Ht	910 12.6 Sm	V UMA	935 10.8 Pt	*101058*
947 12.3 Bn	902 12.2 Ht	T GEM	090151	941 10.0 Al	888 12.4 Bl
W MON	908 12.6 Ht	074323	934 10.3 B	949 10.0 Al	889 12 3 En
064707	911 11.8 Sm	901 9.8 Ch	945 10.4 B	R LEO	904[12.6 Bl
933 10.3 Pt	912 12.6 En	903 10.2 Ch	W CNC	094211	910[12.3 Sm
Y MON	RR MON	905 10.1 Ch	090425	902 6.0 Ch	W VEL
065111	071201	907 10.4 Ch	922 12.6 L	906 6.2 Mh	*101153*
904 10.5 Ch	904 9.4 Ch	911 10.5 Ch	934 12.4 B	907 5.8 Ch	888 8.4 Bl
920 9.2 Pt	935 11.2 Lv	918 10.7 Ch	RW CAR	915 6.0 Wa	889 8.7 Sm
933 9.2 Ph	943 11.3 Lv	920 10.8 Ch	*091868*	916 6.0 Ch	899 8.4 Bl
935 9.1 Lv	944 11.2 Ya	932 11.5 Ch	888 9.0 Bl	933 6.4 Ch	907 8.6 Bl
943 9.0 Lv		933 11.2 Pt	891 9.4 En	933 7.3 Cb	910 9.3 Sm

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1927—Continued.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
U HYA	R CVN	S UMA	RR VIR	RS LIB	Z SCO
103212	115919	123961	*135908*	*151822*	*160021*
924 4.6 L	944[13.0 B	946 8.0 Sg	943 13.0 Pt	889 9.2 Bl	889 10.8 Bl
R UMA	SU VIR	948 8.5 Al	RU HYA	RU LIB	903 10.9 L
103769	120012	955 7.7 Jo	*140528*	*152714*	U SER
906 12.2 Mh	944 11.8 B	RU VIR	889 8.8 Bl	943 13.7 Pt	160210
932 12.2 Ch	935 12.2 Pt	124204	R CEN	R NOR	943 7.8 Pt
934 12.4 B	T VIR	943 13.1 Pt	*140959*	*152849*	X SCO
935 12.3 Pt	*120905*	U VIR	889 6.9 Bl	889 6.0 Bl	*160221a*
945 12.1 B	943 10.5 Pt	124606	890 6.8 Ht	X LIB	889 12.0 Bl
W HYA	944 10.5 B	943 9.0 Pt	899 7.2 Bl	*153020*	SX HER
104620	R CRV	952[10.5 Al	904 7.2 Ht	889 11.9 Bl	160325
888 8.8 Bl	*121418*	U OCT	907 7.7 Bl	W LIB	924 8.9 L
899 8.7 Bl	887 13.6 Bf	*131283*	908 7.5 Ht	*153215*	931 8.8 L
906 9.8 Ch	895 13.8 Bf	885 10.3 Sm	911 7.8 Sm	889 11.2 Bl	943 8.1 Pt
907 8.8 Bl	905 13.7 Bf	888 10.4 Bl	U UMI	S UMI	948 8.0 Pt
913 9.6 Ch	912 13.6 Bf	890 10.2 Ht	141567	153378	949 7.9 Pt
917 9.7 Ch	924 11.9 L	899 9.3 Bl	912 9.3 Ch	912 9.4 Mh	950 7.9 Pt
924 8.4 L	943 11.4 Pt	902 9.2 Ht	943 10.6 Pt	912 8.8 Ch	W SCO
935 7.7 Pt	SS VIR	907 9.2 Bl	S BOO	943 8.9 Pt	*160519*
940 8.6 Ae	122001	908 9.0 Ht	141954	U LIB	889[12.0 Bl
RS HYA	924 8.1 L	910 9.0 Sm	912 8.1 Ch	*153620a*	RU HER
104628	T CVN	R HYA	931 7.8 L	889 11.7 Bl	160625
904[13.7 Bl	122532	*132422*	943 8.4 Gb	T NOR	924 11.8 L
W LEO	935 11.5 Pt	889 8.6 Bl	943 8.5 Pt	*153654*	931 10.8 L
104814	Y VIR	912 9.1 Ch	V BOO	911 9.9 Ht	940 9.2 Ae
889 14.8 Bf	*122803*	917 9.1 Ch	142539a	Z LIB	943 9.5 Pt
895 14.8 Bf	887 11.3 Bf	924 8.4 L	912 8.3 Ch	*154020*	944 9.2 Ae
905 14.5 Bf	895 12.5 Bf	943 8.6 Pt	931 7.8 L	889[12.9 Bl	R SCO
909 14.3 Bf	905 12.7 Bf	S VIR	942 7.2 Gb	R CRB	*161122a*
912 14.4 Bf	912 13.0 Bf	*132706*	943 7.4 Pt	154428	887[14.3 Bf
RS CAR	U CEN	943 10.6 Pt	R BOO	912 6.1 Ch	889[12.2 Bl
110361	*122854*	RV CEN	143227	917 6.0 L	895[14.3 Bf
889[12.3 Sm	904 11.0 Bl	*133155*	912 10.8 Ch	919 6.0 Ch	905[14.3 Bf
891[12.1 Sm	T UMA	888 7.7 Bl	943 12.3 Pt	924 6.0 L	912[14.3 Bf
910[12.3 Sm	123160	899 7.7 Bl	S APS	933 6.1 Pt	S SCO
S LEO	889 8.0 Sg	907 7.7 Bl	*145971*	934 6.0 Gb	*161122b*
110506	906 9.0 Mh	T CEN	889 10.0 Bl	940 5.9 Ae	887 11.1 Bf
934[13.2 B	906 8.9 Ch	*133633*	899 10.0 Bl	942 6.0 Gb	889 11.5 Bl
945 13.6 B	917 9.1 Ch	889 6.0 Bl	907 10.1 Bl	943 6.0 Gb	895 10.7 Bf
RY CAR	935 11.1 B	904 7.9 Ht	911 10.0 Sm	943 6.1 Pt	905 10.8 Bf
111561	935 10.2 Pt	908 8.2 Ht	RT LIB	948 6.1 Pt	912 10.6 Bf
888 11.5 Bl	R VIR	911 8.8 Ht	*150018*	949 6.1 Pt	943 12.0 Pt
899 11.0 Bl	123307	911 9.0 Sm	943 12.6 Pt	950 6.1 Pt	W CRB
907 11.2 Bl	924 10.6 L	RT CEN	T LIB	X CRB	161138
RS CEN	RS UMA	*134236*	*150510*	154536	943 11.2 Pt
111661	123459	889 11.0 Bl	943 12.1 Pt	945 11.5 Pt	W OPH
888 9.0 Bl	887 14.3 Bf	R CVN	S LIB	R SER	*161607*
889 8.9 Sm	895 14.5 Bf	134440	*151520*	154615	924 14.3 L
899 9.2 Bl	905 14.7 Bf	943 10.3 Pt	912 8.0 Ch	912 7.2 Ch	V OPH
907 10.2 Bl	906 8.5 Ch	RX CEN	931 8.8 L	919 7.1 Ch	*162112*
910 10.3 Sm	912 14.8 Bf	*134536*	943 8.6 Pt	943 7.8 Pt	943 8.9 Pt
X CEN	917 8.3 Ch	889[13.1 Bl	S SER	V CRB	U HER
114441	935 14.3 Pt	T APS	151714	154639	162119
888 12.7 Bl	S UMA	*134677*	943 13.1 Pt	943 9.9 Pt	943 12.7 Pt
904 12.5 Bl	123961	885 10.4 Sm	S CRB	RR LIB	SS HER
W CEN	906 8.6 Mh	888 9.9 Bl	151731	*155018*	162807
115058	924 7.8 L	899 9.5 Bl	912 8.0 Ch	912 8.9 Ch	924 9.5 L
888 9.9 Bl	934 7.3 Jo	907 9.6 Bl	943 9.2 Gb	943 8.5 Pt	943 9.3 Pt
899 11.0 Bl	935 7.9 Pt	910 9.4 Sm	943 8.7 Pt	RZ SCO	W HER
907 11.9 Bl	935 7.9 B			*155823*	163137
	941 7.7 Jo			943 12.1 Pt	912 9.1 Ch

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1927—Continued.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
W HER	W PAV	NOV AQL	R CYG	RS CYG	T DEL
163137	*174162*	184300	193449	200938	204016
943 10.1 Pt	889 12.7 Bl	731 10.4 Nk	944 7.3 Pt	901 9.2 Ch	733 9.4 Nk
R DRA	RS OPH	733 10.3 Nk	952 8.8 Al	916 8.1 L	738 9.7 Nk
163266	174406	788 10.4 Nk	RV AQL	919 9.2 Ch	739 9.9 Nk
912 9.6 Ch	943 11.1 Pt	791 10.4 Nk	193509	944 7.7 Pt	740 10.0 Nk
943 11.2 Pt	RY HER	829 10.3 Nk	944 10.2 Pt	R DEL	741 10.2 Nk
RR OPH	175519	943 11.1 Pt	T PAV	201008	742 10.7 Nk
164310	943 13.3 Pt	949 11.1 Pt	*193972*	944 8.1 Pt	RZ CYG
895 14.0 Bf	V DRA	RX LYR	890[12.1 Ht	SX CYG	204846
905 14.2 Bf	175654	185032	904[13.2 Bl	201130	949 12.5 Pt
912 14.2 Bf	943 11.6 Pt	943 13.2 Pt	RT CYG	949 13.6 Pt	S IND
943 13.0 Pt	T HER	R AQL	194048	WX CYG	*204954*
S HER	180531	190108	919 10.4 Ch	201347b	904[13.1 Bl
164715	732 9.8 Nk	943 10.5 Pt	944 9.6 Pt	901 10.6 Ch	R VUL
912 7.4 Ch	740 9.8 Nk	RW SGR	TU CYG	949 10.4 Pt	205923
943 7.9 Pt	742 10.0 Nk	*190819a*	194348	U CYG	949 8.2 Pt
RS SCO	743 10.1 Nk	943 9.3 Pt	919[10.9 Ch	201647	R EQU
164844	821 8.2 Nk	TY AQL	X AQL	730 10.7 Nk	210812
889 7.0 Bl	829 7.2 Nk	*190907*	194604	740 11.0 Nk	949 10.6 Pt
RR SCO	924 12.9 L	943 10.3 Pt	944 11.3 Pt	742 11.0 Nk	T CEP
165030	943 13.0 Pt	X LYR	χ CYG	820 8.1 Nk	210868
889 11.3 Bl	W DRA	190926	194632	821 8.3 Nk	730 6.3 Nk
SS OPH	180565	943 9.0 Pt	919 7.1 Ch	919 8.0 Ch	731 6.2 Nk
165202	943 14.6 Pt	RS LYR	924 6.7 L	949 7.7 Pt	739 6.0 Nk
943 12.2 Pt	X DRA	190933a	939 5.8 Ae	Z DEL	821 7.9 Nk
RT SCO	180666	943 13.4 Pt	944 5.6 Pt	202817	822 7.9 Nk
165636	943 13.7 Pt	RU LYR	NOV CYG	949 9.4 Pt	902 10.2 Ch
889 9.0 Bl	NOV OPH	190941	195553	SZ CYG	915 10.5 Ch
R OPH	180911	943 13.2 Pt	943[12.2 Pt	202946	923 9.9 L
170215	943[13.0 Pt	U DRA	949 12.2 Pt	933 9.0 Pt	933 10.3 Pt
912 8.4 Ch	TV HER	190967	Z CYG	935 9.2 Pt	X PEG
943 9.3 Pt	181031	943 10.1 Pt	195849	936 9.4 Pt	211614
RW SCO	924 11.6 L	W AQL	730 10.2 Nk	942 9.4 Pt	949 9.8 Pt
170833	RY OPH	*191007*	733 10.0 Nk	943 9.2 Pt	W CYG
889[11.5 Bl	181103	943 9.5 Pt	738 9.5 Nk	948 9.0 Pt	213244
Z OPH	943 11.0 Pt	T SGR	739 9.4 Nk	949 8.9 Pt	916 5.5 L
171401	W LYR	*191017*	740 9.4 Nk	950 8.8 Pt	922 5.8 L
943 10.4 Pt	181136	943 12.2 Pt	741 9.3 Nk	ST CYG	S CEP
RS HER	924 11.0 L	R SGR	742 9.3 Nk	202954	213678
171723	943 9.1 Pt	*191019*	821 9.0 Nk	949 13.8 Pt	902 9.2 Ch
732 8.4 Nk	SV HER	943 11.5 Pt	822 9.2 Nk	V VEL	930 9.8 Ch
733 8.4 Nk	182224	RY SGR	825 9.2 Nk	203226	933 9.1 Pt
735 8.4 Nk	924 11.7 L	*191033*	828 9.3 Nk	949 8.5 Pt	RU CYG
740 8.5 Nk	943 12.7 Pt	949 6.7 Pt	829 9.4 Nk	S DEL	213753
943 8.1 Pt	X OPH	950 6.5 Pt	847 10.4 Nk	203816	902 9.0 Ch
S OCT	183308	S SGR	944 12.2 Pt	731 10.2 Nk	933 9.0 Pt
172486	924 8.4 L	*191319a*	S TEL	733 9.9 Nk	RV CYG
885 12.0 Sm	943 8.3 Pt	943 11.5 Pt	*195855*	738 10.2 Nk	213937
888 11.6 Bl	R SCT	TZ CYG	904[12.0 Bl	739 10.2 Nk	933 6.6 Pt
890 11.7 Ht	*184205*	191350	SY AQL	740 10.1 Nk	RR PEG
891 11.3 En	791 5.7 Nk	943 10.0 Pt	*200212*	741 10.1 Nk	214024
899 10.5 Bl	919 5.0 Ch	U LYR	944 12.0 Pt	742 10.1 Nk	949 9.8 Pt
902 10.6 Ht	924 5.0 L	191637	S AQL	790 9.3 Nk	R GRU
908 10.0 Ht	943 5.4 Pt	943 10.5 Pt	*200715a*	791 9.4 Nk	*214247*
911 8.9 Sm	944 5.6 Ae	RT AQL	944 9.5 Pt	949 11.9 Pt	889[12.4 En
RU OPH	949 5.8 Pt	193311	RW AQL	V CYG	904[12.9 Bl
172809	950 6.0 Pt	919 10.8 Ch	*200715b*	203847	RT PEG
943 12.7 Pt	RW LYR	943 9.7 Pt	944 9.2 Pt	949 11.0 Pt	215934
RU SCO	184243	R CYG	Z AQL	T DEL	933 11.7 Pt
173543	943 12.3 Pt	193449	*200906*	204016	
889 11.1 Bl		919 7.6 Ch	944 12.2 Pt	731 9.3 Nk	

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1927—Continued.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
T PEG	S GRU	T TUC	W PEG	ST AND	V CET
220412	*221948*	*223462*	231425	233335	*235209*
922 12.0 L	889 12.2 En	903 7.7 En	903 11.2 Ch	902 10.7 Ch	904 12.4 Bl
Y PEG	890 12.2 Ht	908 8.2 Ht	922 11.4 L	927 11.4 Lg	R TUC
220613	902 11.0 En	911 8.2 Sm	V PHE	932 10.8 Lg	*235265*
883 14.1 Bg	912 10.0 En	R LAC	*232746*	933 10.8 Pt	889 11.0 En
889 14.8 Bg	S LAC	223841	888 9.5 Sm	R AQR	889 12.0 Sm
893 14.6 Bf	222439	922 14.0 L	889 9.3 En	*233815*	903 12.0 En
RS PEG	903 8.7 Ch	RW PEG	890 9.0 Ht	901 9.0 Cb	910 12.6 En
220714	922 9.9 L	225914	902 9.5 Ht	911 9.4 Cb	910 12.4 Sm
883 11.4 Bg	933 10.6 Pt	883 10.7 Bg	902 9.6 En	Z CAS	R CAS
889 10.6 Bg	R IND	890 10.7 Bg	908 9.7 Ht	233956	235350
893 10.4 Bf	*222867*	893 11.2 Bf	910 9.7 Sm	930 13.0 Lv	902 11.4 Ch
X AGR	888 12.5 Bl	901 11.7 Bg	912 9.9 En	940 11.7 Ae	930 12.5 Lv
221321	899 10.8 Bl	906 11.9 Bg	Z AND	944 11.0 Ae	Z PEG
891 9.7 Bg	907 9.9 Bl	908 12.2 Bg	232848	RR CAS	235525
T GRU	T TUC	911 12.4 Bg	902 9.0 Ch	235053	933 12.6 Pt
221938	*223462*	V CAS	933 9.3 Pt	902 10.5 Ch	SV AND
888 8.8 Sm	889 8.0 Sm	230759	934 9.2 Ae	936 10.9 Bn	235939
S GRU	890 7.8 Ht	913 7.4 Ch	938 9.1 Ae	947 11.3 Bn	933 11.4 Pt
221948	891 8.0 En	933 7.9 Pt	940 9.1 Ae		
888 12.2 Sm	902 7.8 Ht				

RAPIDLY VARYING IRREGULAR VARIABLES.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
005840 RX ANDROMEDAE—				
	4933.5	13.0 Pt	4948.5	11.7 Pt
	4935.5	13.3 Pt	4949.5	11.7 Pt
	4936.5	12.4 Pt	4950.5	11.3 Pt
	4942.5	13.0 Pt	4953.5	11.0 Pt
	4943.5	12.4 Pt	4955.5	11.0 Pt
	4944.5	12.4 Pt	4958.5	11.0 Pt
064547 SS AURIGAE—				
	4883.1	14.8 Bg	4941.5	12.8 Ie
	4884.1	14.8 Bg	4942.5	12.6 Pt
	4889.1	14.8 Bg	4943.6	13.7 B
	4892.2	14.5 Bf	4943.6	13.9 Ie
	4907.1	14.8 Bg	4944.6	13.8 B
	4908.1	14.8 Bg	4944.6	13.3 Ae
	4909.2	14.9 Bf	4945.6	13.7 B
	4910.1	14.9 Bg	4948.5	12.4 Pt
	4911.1	15.0 Bg	4949.5	12.6 Pt
	4924.6	13.0 L	4950.5	12.4 Pt
	4931.3	14.5 L	4953.6	12.4 B
	4933.7	13.7 B	4955.5	12.6 Pt
	4935.7	13.9 Lv	4956.5	12.6 Pt
	4936.5	10.7 Pt	4958.5	12.4 Pt
	4940.5	12.0 Ie		
074922 U GEMINORUM—				
	4883.1	14.2 Bg	4906.1	10.2 Bf
	4884.1	14.4 Bg	4906.6	10.2 Ph
	4901.1	12.4 Bf	4907.0	10.7 Ch
	4902.1	9.2 Bf	4907.1	10.6 Bf
	4902.1	9.3 Ch	4907.6	10.4 Ph
	4903.1	9.3 Ch	4908.0	11.4 Ch
	4904.1	9.6 Ch	4908.1	11.2 Bg
	4905.1	9.9 Bf	4909.2	12.4 Bf
	4905.0	10.1 Ch	4910.1	13.4 Bg
	4906.0	10.2 Ch	4911.1	13.7 Bg
074922 U GEMINORUM—Continued				
	4915.6	11.4 Wa	4943.7	13.8 Lv
	4917.1	13.8 Ch	4944.6	13.7 Ae
	4919.1	13.3 Ch	4944.7	11.7 Wa
	4933.7	13.3 Pt	4948.5	13.3 Pt
	4935.7	13.8 Lv	4949.5	13.3 Pt
	4936.5	12.4 Pt	4950.5	12.3 Pt
	4937.7	12.2 Ph	4955.5	11.3 Pt
	4940.5	13.3 Ie	4956.5	11.3 Pt
	4940.6	13.9 Ae	4958.5	11.7 Pt
	4942.5	12.4 Pt		
213843 SS CYGNI—				
	4730.0	11.9 Nk	4905.0	10.4 Nk
	4731.0	11.8 Nk	4906.0	10.1 Ch
	4738.1	11.3 Nk	4907.0	11.3 Ch
	4739.2	11.7 Nk	4912.0	11.5 Ch
	4740.2	11.7 Nk	4916.3	11.2 L
	4741.2	11.7 Nk	4922.2	11.8 L
	4742.2	11.7 Nk	4923.2	11.4 L
	4820.0	11.4 Nk	4925.3	11.3 L
	4821.0	11.5 Nk	4931.6	11.8 L
	4824.0	10.7 Nk	4932.3	11.7 L
	4826.9	11.4 Nk	4933.5	11.7 Pt
	4829.0	11.4 Nk	4936.5	11.7 Pt
	4831.9	11.2 Nk	4939.9	8.9 Ae
	4846.9	9.3 Nk	4940.5	8.7 Cl
	4848.9	9.6 Nk	4942.5	9.3 Pt
	4859.1	12.0 Nk	4942.9	8.9 Ae
	4900.0	8.8 Ch	4943.9	9.5 Pt
	4901.0	8.9 Ch	4944.9	9.8 Ae
	4902.0	9.0 Ch	4949.9	11.2 Ae
	4903.0	9.5 Ch	4949.9	11.7 Pt
	4904.0	9.8 Ch	4950.9	11.7 Pt

Total observations, 1440; Total variables, 322; Total observers, 31.

Father E. C. Phillips of the Georgetown College Observatory, contributes for

the first time to our columns. It will be recalled that it was at this Observatory that Father Hagen carried on much of his monumental work on variable stars and their comparison star sequences.

The following observers have contributed to the results here presented: Miss Allen, "Ae"; Messrs. Allen, "Al"; Baldwin, "Bl"; Barnes, "Bx"; Bappu, "Bg"; Bhaskaran, "Bf"; Bouton, "B"; Brown, "Bn"; Chandra, "Ch"; Cherrington, "Cb"; Clement, "Cl"; Ebert, "Eb"; Ensor, "En"; Gaebler, "Gb"; Greenberg, "Gg"; Houghton, "Ht"; Iedema, "Ie"; Jones, "Jo"; Kurtz, "Kz"; Lacchini, "L"; Leavenworth, "Lv"; Logan, "Lg"; Marshall, "Mh"; Nakamura, "Nk"; Peltier, "Pt"; Phillips, "Ph"; Rowley, "Rw"; Skaggs, "Sg"; Smith, "Sm"; Watson, "Wa"; Yalden, "Ya".

LEON CAMPBELL, Recording Secretary,
April 7, 1927. Harvard Observatory, Cambridge, Mass.

COMMUNICATIONS.

"The Undevout Astronomer is Mad".—The paper by David B. Pickering ("The Astronomical Fraternity of the World") in March issue of POPULAR ASTRONOMY was very helpful and inspiring to me. To visit distant and beautiful scenes in the interests of the grandest of sciences, to meet and form new friendships with representatives of that science, what could be more delightful and satisfying! The very caption of the article immediately appealed to me and suggested possibilities of world-wide appeal. With a fraternity of astronomers of sufficient strength world peace would be automatically assured. And by "astronomers" as I here use the word I do not mean that they should of necessity be professionals, mathematicians, etc. The vast majority might, like the writer, be merely star gazers, sufficiently earnest and with enough persistence in study to enable the mastery of star and group names, names and places of planets, simple and general facts connected with "the stars in their courses" in general and with the innumerable interesting things bearing upon the solar system in particular. Spare moments devoted to this line of research would so broaden the average mind that it would be lifted from the mental atrophy resulting from habitual grovelling in comic strips and other forms of cheap literature and entertainment, which may truly be called time killers, and new ideals would quickly follow. New concepts would form, new mental habits would be given birth. Finally the plane would be reached whereon "wars and rumors of wars," as well as all other phases of present human discord, would become merely memories of a dark past.

CHAS. H. MACKAY.

Long Lake, Bridgton, Maine, April 8, 1927.

Note on the Occultation of Saturn, March 24, 1927.—It may be of interest to your readers to know that Mandeville, Jamaica, was just far enough south for the occultation of Saturn to be observed.

As I am in the process of changing my first home-made telescope, an eight-inch mirror, into a twelve-inch, also home-made, it was impossible for me to take any measures of the occurrence. I contented myself with observing the contacts and noting the time.

At first there was considerable haze and a little cloud. Dew troubled my flat all through the observation.

First contact of ring with limb of moon	$6^h\ 22^m$ G.C.T.
First contact ball of Saturn	6 23.25
Ball half occulted	6 24.5
Ball disappeared (much haze)	6 26.2
Rings probably gone	6 29

In changing eyepieces from x130 to x230 and back again on account of haze, and looking after a bedewed flat, I lost the place on the moon's limb where Saturn disappeared. Having no position circle at the moment on the telescope the planet appeared also before I was aware and I only got last contact of ball and rings.

Last contact of ball	$6^h\ 44^m75$
Last contact of ring	6 45.5

From these crude takings of time I judge the ball of Saturn to have been occulted for a period of about sixteen minutes.

Time was checked by the Mandeville postoffice, which receives standard time over the wire every day from Kingston, Jamaica.

My observatory is situated about three-quarters of a mile west of Professor Pickering's and about an eighth of a mile north. I have not as yet had the chance to get my position exactly.

G. H. Hamilton.

The Hamilton Observatory, Mandeville, Jamaica.

GENERAL NOTES.

Professor Ralph H. Curtiss has been made director of the observatory and chairman of the department of astronomy in the University of Michigan, in succession to the late Professor William J. Hussey. Professor Curtiss has been assistant director of the observatory of the University of Michigan since 1911, and in charge of astrophysical research at that institution since 1907.

Professor H. H. Turner Honored.—On Charter Day, March 23, at the University of California, the degree of Doctor of Laws was conferred upon Professor H. H. Turner, of Oxford University, who is at present giving a course of lectures in astronomy at the University of California. (*Publ. of the A.S.P.*, April, 1927.)

Dr. Edwin P. Hubble on March 27 delivered an address in Washington, D. C., under the auspices of the Carnegie Institution of Washington. In his address Dr. Hubble said that the study of astronomy was the study of receding horizons. He spoke principally of his researches on the spiral nebulae, and pointed out the bearing of his discoveries upon the conception of the universe of space. With present day equipment the boundary has been pushed out a distance of about 140,000,000 light-years. With still further improved instrumental equipment, which he thinks entirely practicable, the boundary may be moved to a distance of one million million light-years. Such studies, Dr. Hubble stated, extend not only into the very remote spaces, but also into the very distant past.

International Astronomical Union Meeting.—According to a notice issued by Professor F. J. M. Stratton, General Secretary, the next meeting of the International Astronomical Union will be held at Leiden, Holland, commencing July 5, 1928.

Sir Isaac Newton's Anniversary Observed. — The two-hundredth anniversary of the death of Sir Isaac Newton was observed at Cornell University by a public meeting held by Sigma Xi, at which Dr. William F. G. Swann, professor of physics and director of the Sloane Laboratory at Yale University, was the speaker. (*Science*, April 15, 1927.)

Harvard College Observatory Station. — It has recently been decided to transfer the equipment of the Boyden Station, which since 1890 has been located at Arequipa, Peru, to a point in South Africa, probably near Bloemfontein, the purpose being to secure better observing conditions. The equipment of the station will at the same time be augmented by a 60-inch reflector, which is now being constructed. This will be the largest instrument in South Africa, and will be used for photographic, photometric, and spectroscopic work on stars and nebulae.

The Ritchey-Dina Telescope. — Since the paper by David B. Pickering (p. 258) was written word has come that the Ritchey-Dina project, as such, has been abandoned, and that Professor Ritchey has been engaged by the Paris Observatory to make two 20-inch mirrors, one of the old type and one of the new cellular type in order to test and prove, if possible, the superiority of the latter over the former.

Eclipse Expedition to Norway. — Word has been received that Dr. Harlan T. Stetson, of the Astronomical Laboratory of Harvard University, has been appointed research assistant of the Smithsonian Institution, and will accompany the McCormick-Chaloner Eclipse Expedition under the auspices of the Smithsonian Institution to Norway for the purpose of observing the total eclipse of the sun on June 29. Dr. Stetson will devote his attention principally to photometric work, measuring the total illumination with a Macbeth Illuminometer, and operate simultaneously a photographic photometer, giving not only the brightness of the corona in magnitudes but also its color index, as was done at Sumatra last year. In addition he will take with him a photographic telescope of eight-feet focus for obtaining direct photographs of the corona for the purposes of a study of the distribution of the coronal light.

Sir Isaac Newton's Bi-Centenary. — The History of Science Society, in collaboration with committees from The American Mathematical Society, Mathematical Association of America, American Astronomical Society and the American Physical Society, proposes to commemorate the 200th anniversary of the death of Sir Isaac Newton by an appropriate program at Columbia University, New York, November 25 and 26, 1927.

On this occasion it is planned to have addresses relating to the great contributions of Newton to the advancement of mathematics, astronomy, and physics, and setting forth his interests in chemistry, chronology, theology, and other branches of learning. It is also hoped that some reference will be made to Newton's early contribution to the advancement of science in the American Colonies—when Harvard and Yale Colleges were in their infancy. Each subject will be represented by at least two papers given by scholars of distinction.

It is proposed to have a large exhibition of Newtoniana, including the first edition of the *Principia*, and other related publications, also portraits, medals, and autographed letters and documents, and such material as bears directly upon his life, achievements and contemporaries. Therefore it is hoped that those who

have material of this nature will take pleasure in loaning it to the committee in charge of the exhibit; it is requested that those who can contribute will communicate as soon as possible with the secretary. (*Science*, April 1, 1927.)

The Ft. Worth Astronomical and Physical Society was organized at the Texas Christian University, on Friday evening, April 1, with 18 charter members. Mr. G. F. Townsend, a Texas pioneer in the field of X-Ray and electrics, and an amateur astronomer, was elected president of the organization. Mr. Sterling Bunch was elected secretary-treasurer. Professor Newton Gaines, head of the Physics Department, Texas Christian University, lectured on "Ultraviolet Light" at the first meeting, illustrating at various points with experiments and demonstrations made with the University's excellent laboratory equipment.

The aim of the Society is to promote the study of astronomy and physics in Ft. Worth, and to furnish an opportunity for the professional and amateur scientists of this city to get together and discuss topics of common interest. Meetings will be held on the first Friday evenings in each month.

One of the plans of the organization for the future is a thoroughly up-to-date astronomical observatory for Ft. Worth. A ten-inch Clark refractor, equatorially mounted, together with complete micrometric, spectroscopic and photographic accessories, is already available, as is also a nearly complete equipment for an astrophysical laboratory. It is the aim of the Society to establish an observatory in Ft. Worth, thoroughly modern in every respect, and to lay out a regular program of research work, setting aside a portion of the time for popular instruction in the science.

In addition to this society a junior Astronomical Club has been formed. This club is made up of about sixty boys and girls, seniors in Central High School, Fort Worth. It is really a class in astronomy under the direction of Miss Charlie Noble. Plans for out of door meetings with a telescope, illustrated lectures and other meetings for the coming summer are under way.

STERLING BUNCH.

1520 Lagonda Ave., Ft. Worth, Texas.

Amateur Astronomical Society Announcement.— Have you an amateur's interest in Astronomy? If so, you are cordially invited to attend a meeting at 8:00 o'clock on Tuesday evening, May 10, 1927, in the American Museum of Natural History, for the purpose of organizing a popular astronomical society. The Royal Astronomical Society of Canada, with local chapters in all the principal cities of the Dominion, has long made its appeal to the general public. In Germany, cities with only a fraction of the population of New York have successful societies for non-technical astronomers. Upon investigation, we have found a real demand for such an organization in our midst. If the interest proves to be as great as we think it will be, application may be made for affiliation with the New York Academy of Sciences, and chapters may be organized in other cities. At this preliminary meeting, Professor Henry Fairfield Osborn, President of the American Museum of Natural History, will deliver an address of welcome, and Dr. Oswald Schlockow, District Superintendent, New York City Public Schools, will discuss the need of such an organization. Come and bring your friends who are interested in the evening sky.

CLYDE FISHER, Curator, in Charge of Astronomy.